Plastics

DEALING WITH THE MANUFACTURE, USES AND POTENTIALITIES OF PLASTIC MATERIALS

taken

at

random

Take the pens, for instance: they're good to handle — and even a schoolboy would find them hard to break. Cellulose acetate is tough.

Take the table lighter: a luxury article. Cellulose acetate — unlike so many other plastics — is unaffected by petrol; and what plastic has a finish more luxurious?

Take the miniature oiling pen: cellulose acetate's clean transparency and imperviousness to oil puts a good idea into its most practical form.

Take the globe and its stand (all cellulose acetate), put your finger on any region, and it's more than likely that they're using products made with Courtaulds' cellulose acetate moulding powders.

Courtaulds

cellulose acetate moulding powders

Courtaulds' Technical Service
welcome your enquiries about any aspect of plastics.
Plastics Division: Little Heath, Coventry
Telephone: Coventry 88031.
16 St. Martin's-le-Grand, London, E.C.1.
Telephone: Monarch 8811.

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and durable
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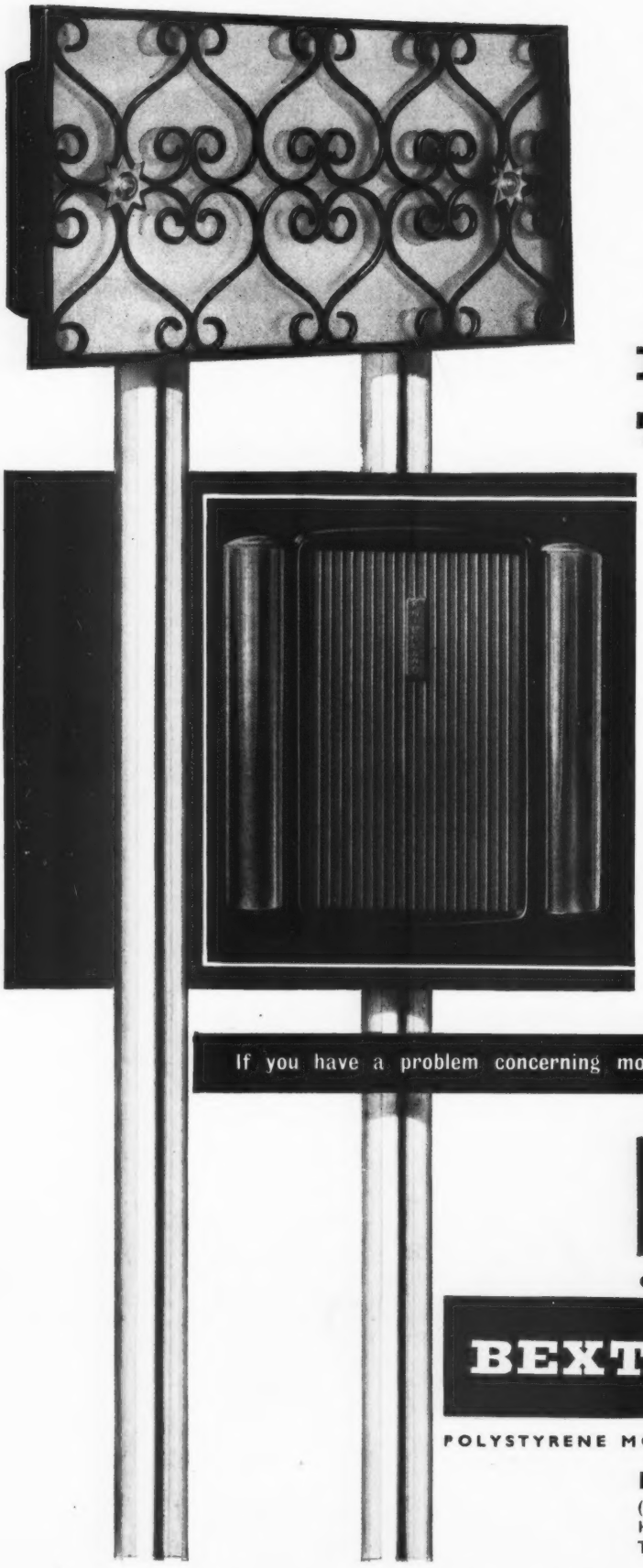
no fire risks
clean contours



BX RINGS THE BELL

Ornamental Grille and Reflector Plate of the "Monarch" Electric Door Chime is moulded from Bexoid, and the two tone front panel of the "Warbler" Mark II from Bextrene. Both these elegant cases are moulded by Messrs. Punfield & Barstow Ltd. for Messrs. F. & E. Friedland of Macclesfield.

If you have a problem concerning moulding powders — contact BX first

BEXOID

CELLULOSE ACETATE MOULDING POWDER

BEXTRENE

POLYSTYRENE MOULDING POWDER

BX PLASTICS LIMITED
(A subsidiary of The British Xylonite Co., Ltd.)
Higham Station Avenue, London, E.4.
Tel: LARkswood 5511.

All New HPM

THE WORLD'S *MOST COMPLETE LINE* OF PLASTICS INJECTION MACHINES!

STANDARD INJECTION MACHINES

MODEL NUMBER	150-H-6	300-H-12	400-H-20	800-H-48
Capacity (oz.–Single Feed)	6	12	20	48
Capacity (oz.–Double Feed)	8	16	28	64
Material Injected (cu. in. per min.)	440	1150	1245	2410
Plasticizing Capacity (lbs. per hour)	80	135	200	300
Mould Clamp Capacity (tons)	150	300	400	800
Mould Space (hor. × vert.):				
(a) Full Platen Vert.	10½″ × 25″	16½″ × 33″	20½″ × 42″	36″ × 54″
(b) Full Platen Hor.	20½″ × 15″	30″ × 20″	36″ × 26½″	54″ × 36″
Daylight Opening without Ram Spacer	20″	30″	40″	55″
Daylight Opening with Ram Spacer	16″	26″	34″	47″
Mould Thickness without Ram Spacer	10″	10″	15″	20″
Mould Thickness with Ram Spacer	6″	6″	9″	12″
Clamp Travel (max.)	10″	20″	25″	35″
Motor Horse-power	20	40	50	100
Shipping Weight (pounds)	14500	22000	39000	75000

NOTE: All ratings based on moulding general purpose polystyrene

Other H.P.M. Models are available with these capacities:—

STANDARD
Model 400-H-32 Capacity 32 ounces.
,, 1200-H-80 ,, 80/100 ,,

PRE-PLASTICIZING
Model 400-P48A Capacity 48 ounces.
,, 1200-P200 ,, 200 ,,
,, 3000-P400A ,, 400 ,,

From 6 ounces to 400 ounces; with mould clamping pressures from 150 tons to 3,000 tons . . . that's the scope of the new H.P.M. range.

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May we send you further details

MODEL NUMBER 400-H-20

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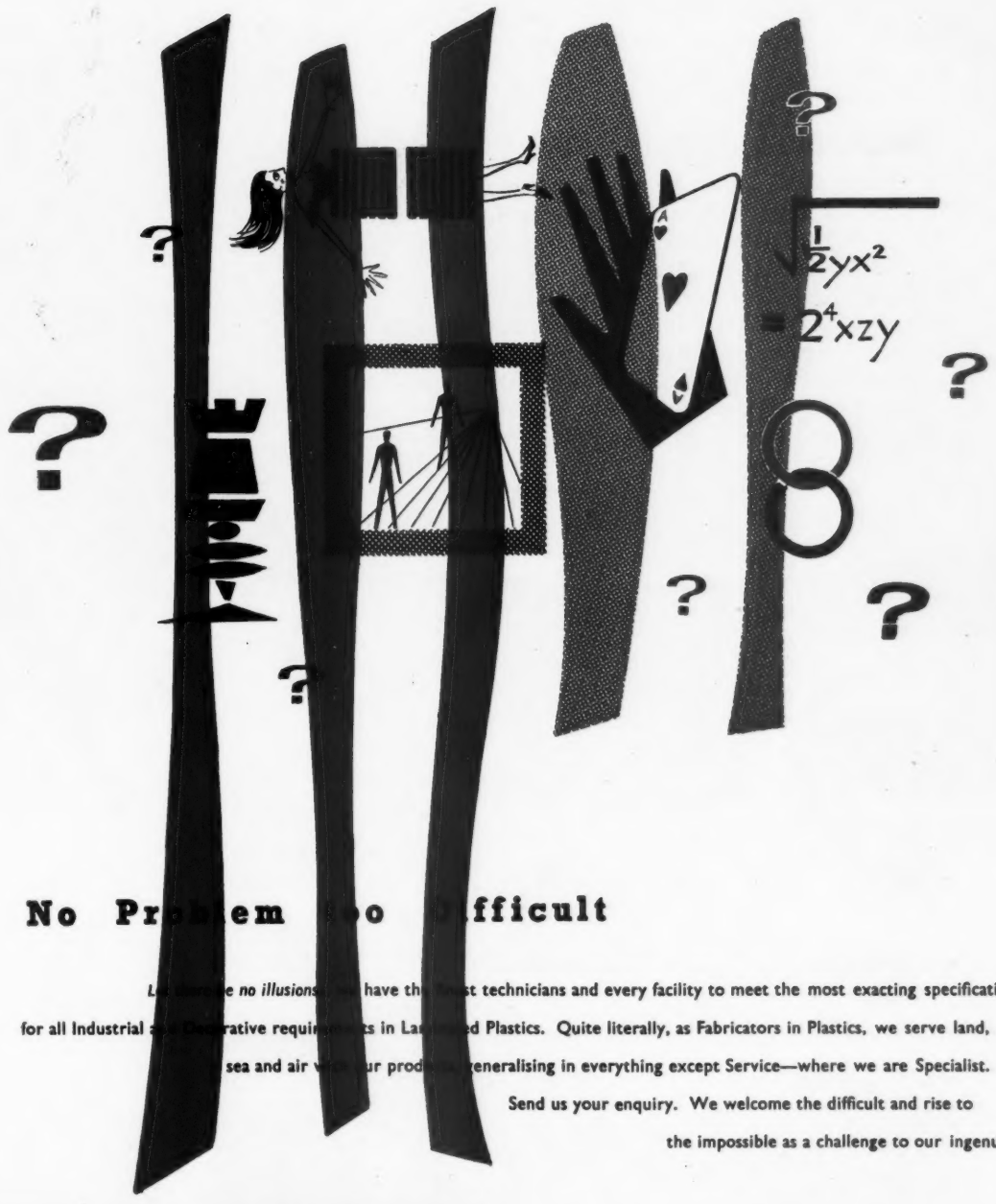

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* *PAXOLIN is a registered trade mark.*

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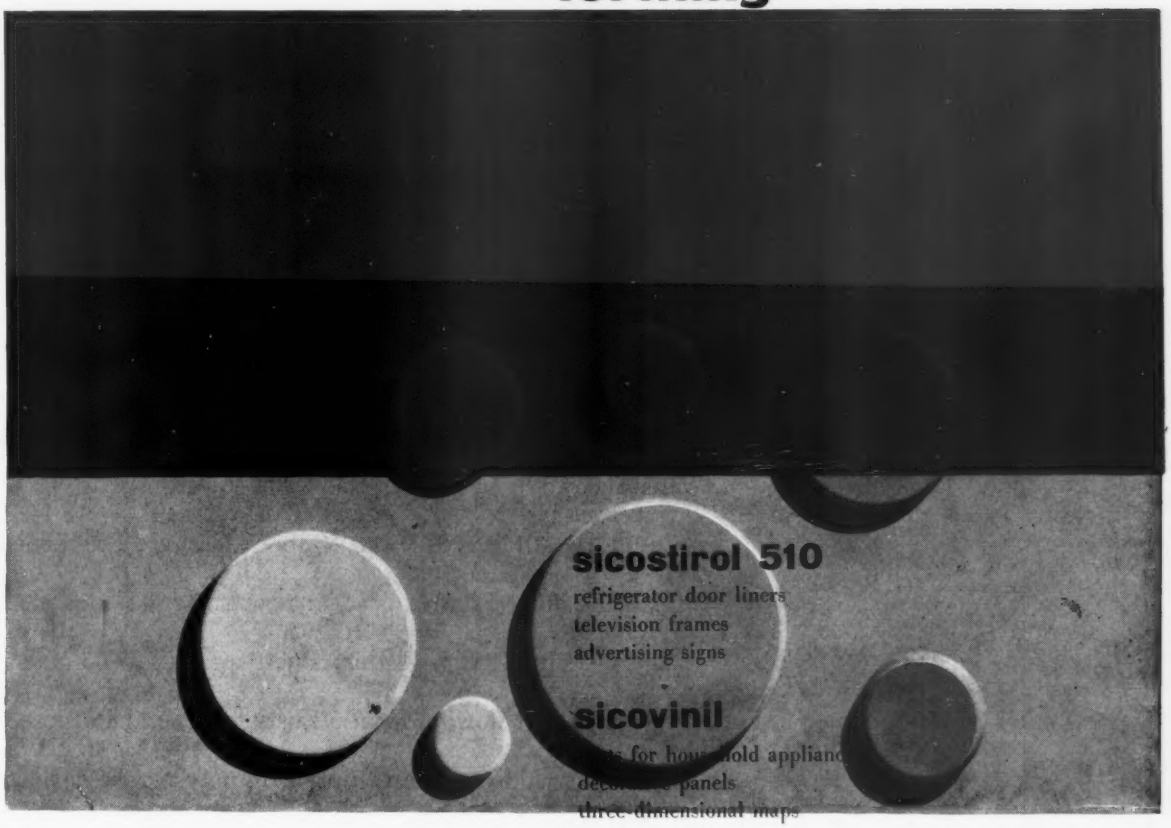

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Modulus of Elasticity in Tension	lb/in²	„ „	$3.5–4.5\times10^5$	$3.0–4.0\times10^5$
Flexural Strength	„	ASTMD.790–49T	7000–8000	7000–9000
Deflection	ins	„ „	No failure	No failure
Izod Impact Strength	$\frac{1}{2}\times\frac{1}{4}$" bar ft.lb/in of notch	ASTMD.256–47T	0.7–1.0	0.9–1.3
Softening Point	°C	B.1493	86–90	85–89
Specific Gravity		„	1.05	1.05

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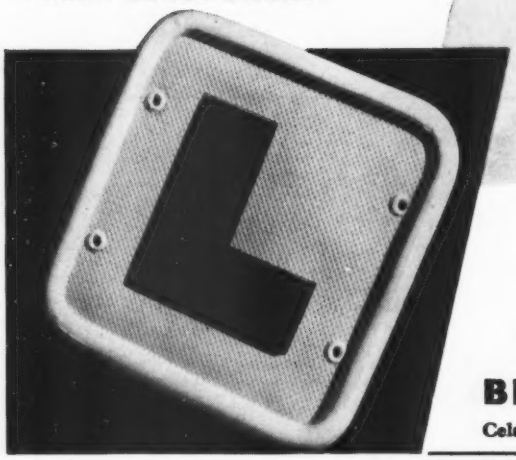

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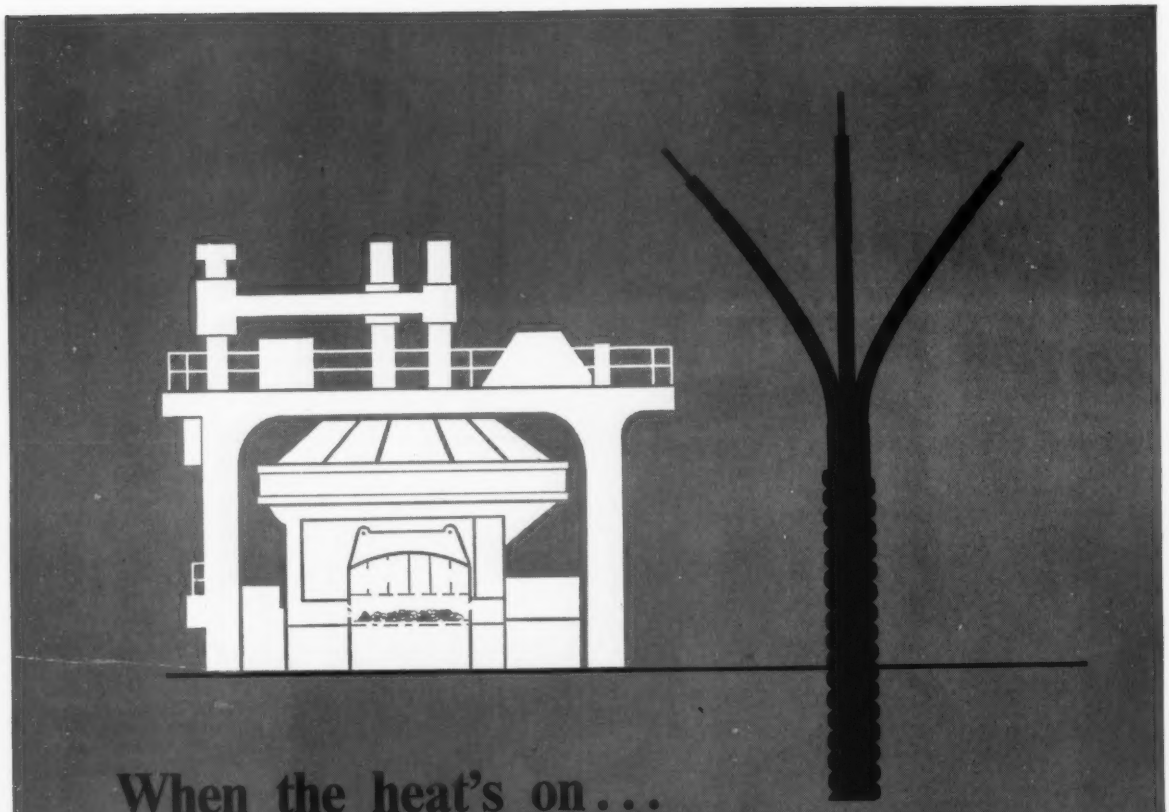

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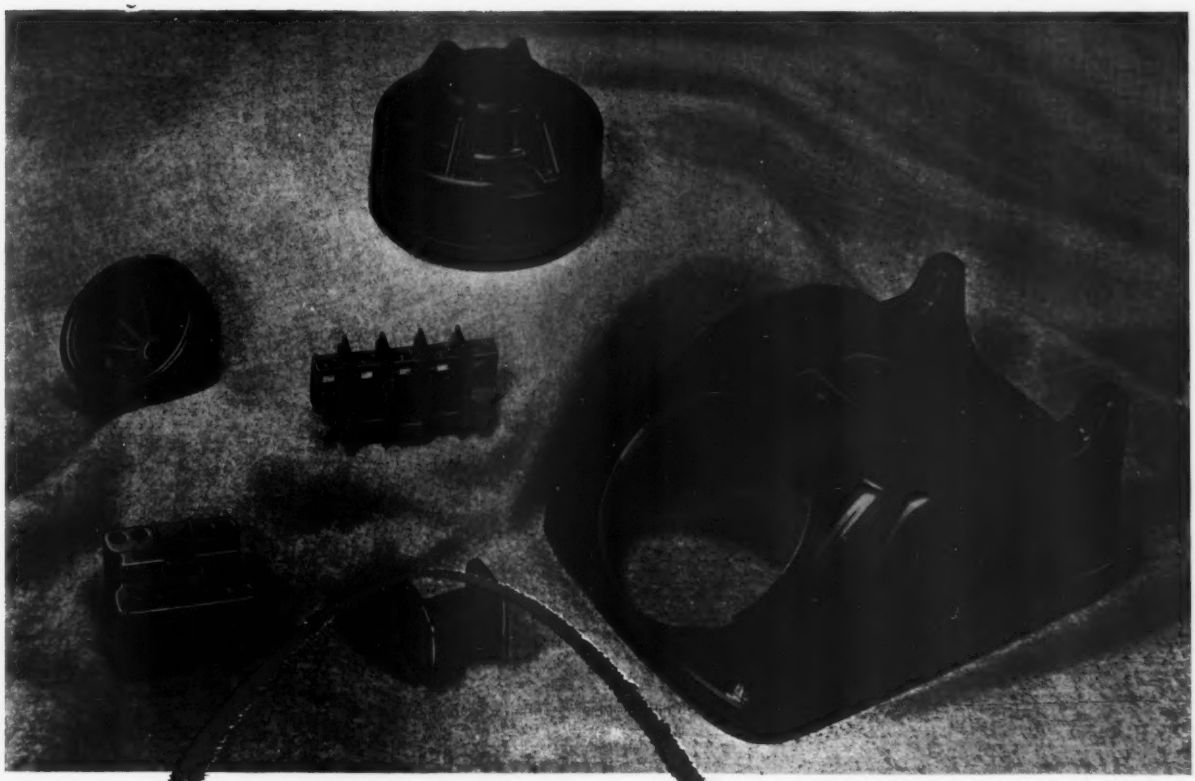
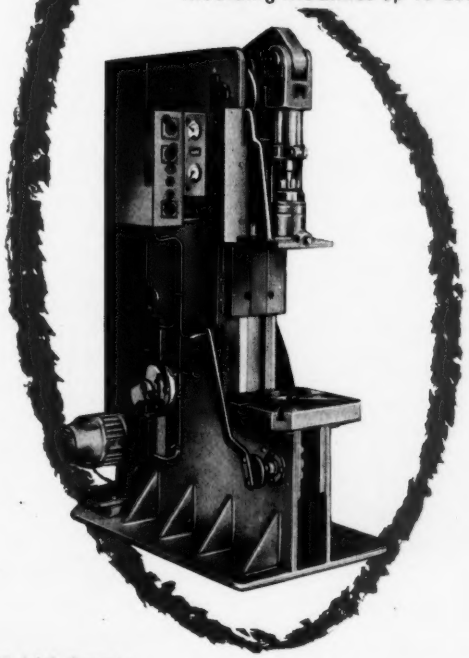


Above are some articles made on **BATTENFELD** Compression- and Transfer Moulding Machines up to 200 tons



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Injection Molding Machines, 1/4 up to 50 ozs.
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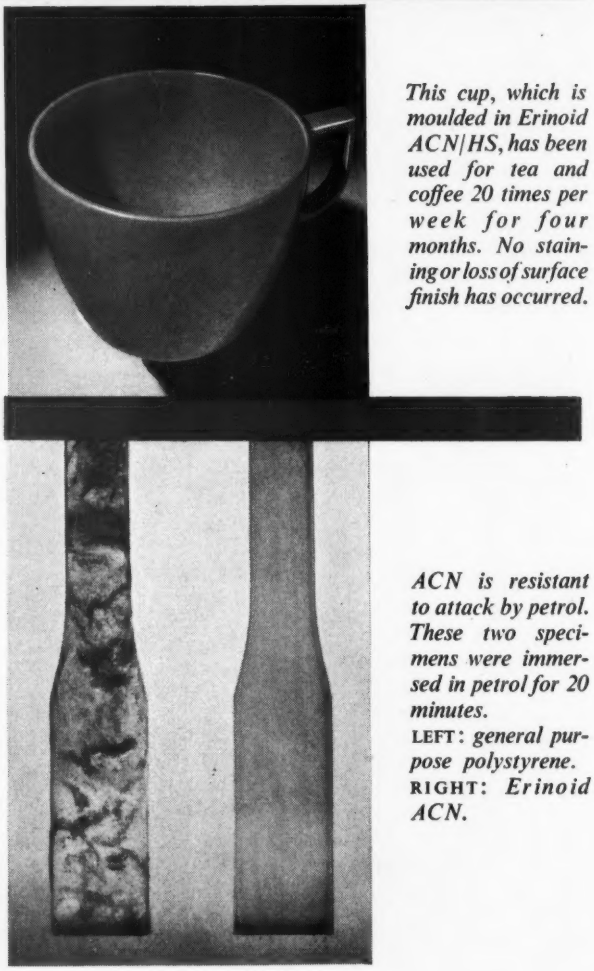
Erinoid

ACN grade

STYRENE ACRYLONITRILE COPOLYMER



This cup, which is moulded in Erinoid ACN/HS, has been used for tea and coffee 20 times per week for four months. No staining or loss of surface finish has occurred.

This new grade of Erinoid polystyrene has a strength 50–100% greater than general purpose polystyrene. It has good resistance to attack by petrol, white spirit, fruit juices, acids, alkalis, fats, inks and disinfectants. Mouldings are not stained by tea or coffee. Metal inserts can be moulded in and the material has excellent electrical properties.

Two grades are available—ACN and ACN/HS. They have similar properties, apart from softening point and flow:

ACN — Softening point: 92°C. (B.S.1493)

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Both grades are easily moulded and extruded. The base colour is a transparent straw shade and therefore transparent colours, including blue tint, are available.

ACN is resistant to attack by petrol. These two specimens were immersed in petrol for 20 minutes.
LEFT: *general purpose polystyrene.*
RIGHT: *Erinoid ACN.*

This new material is manufactured by

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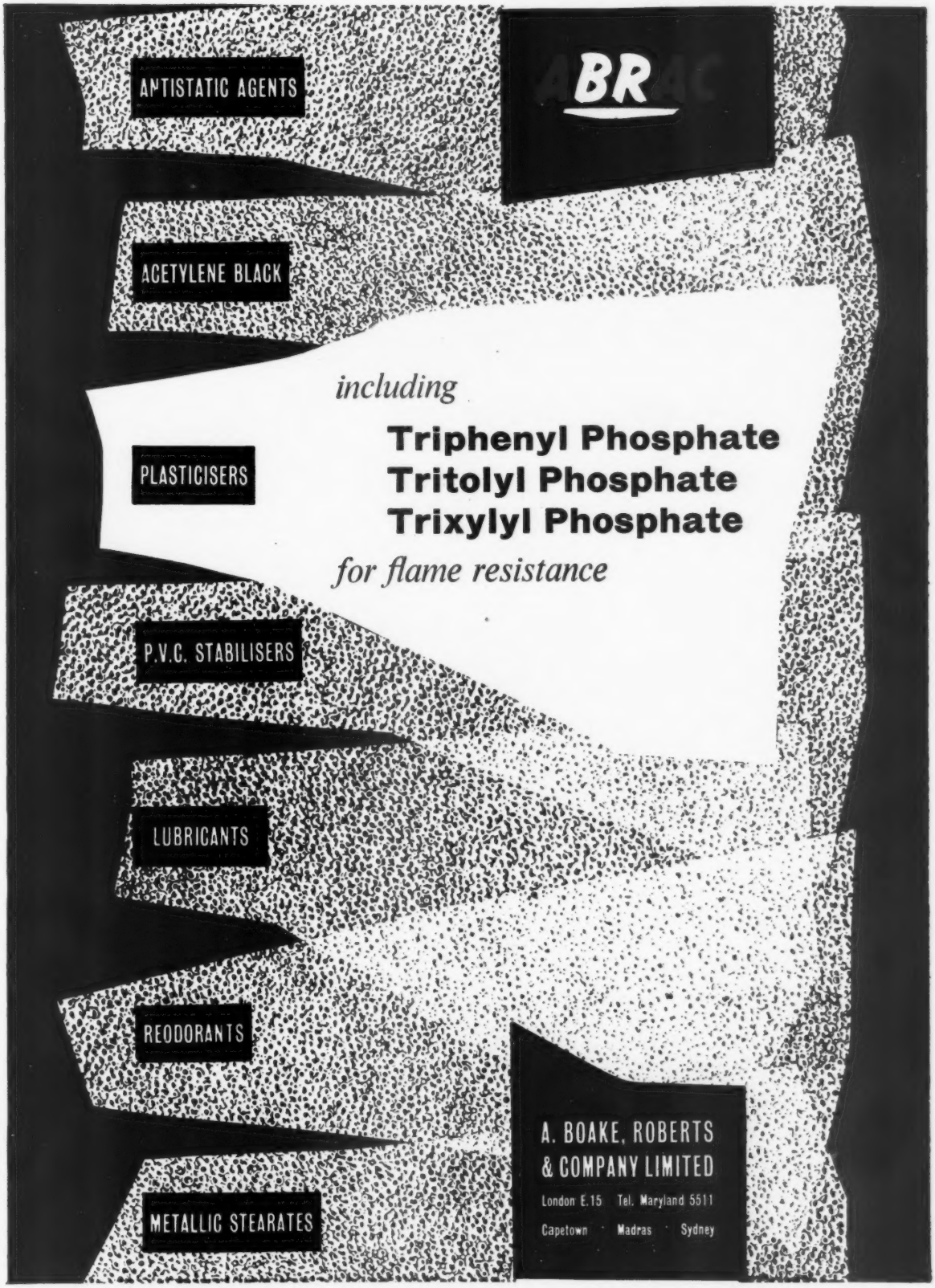
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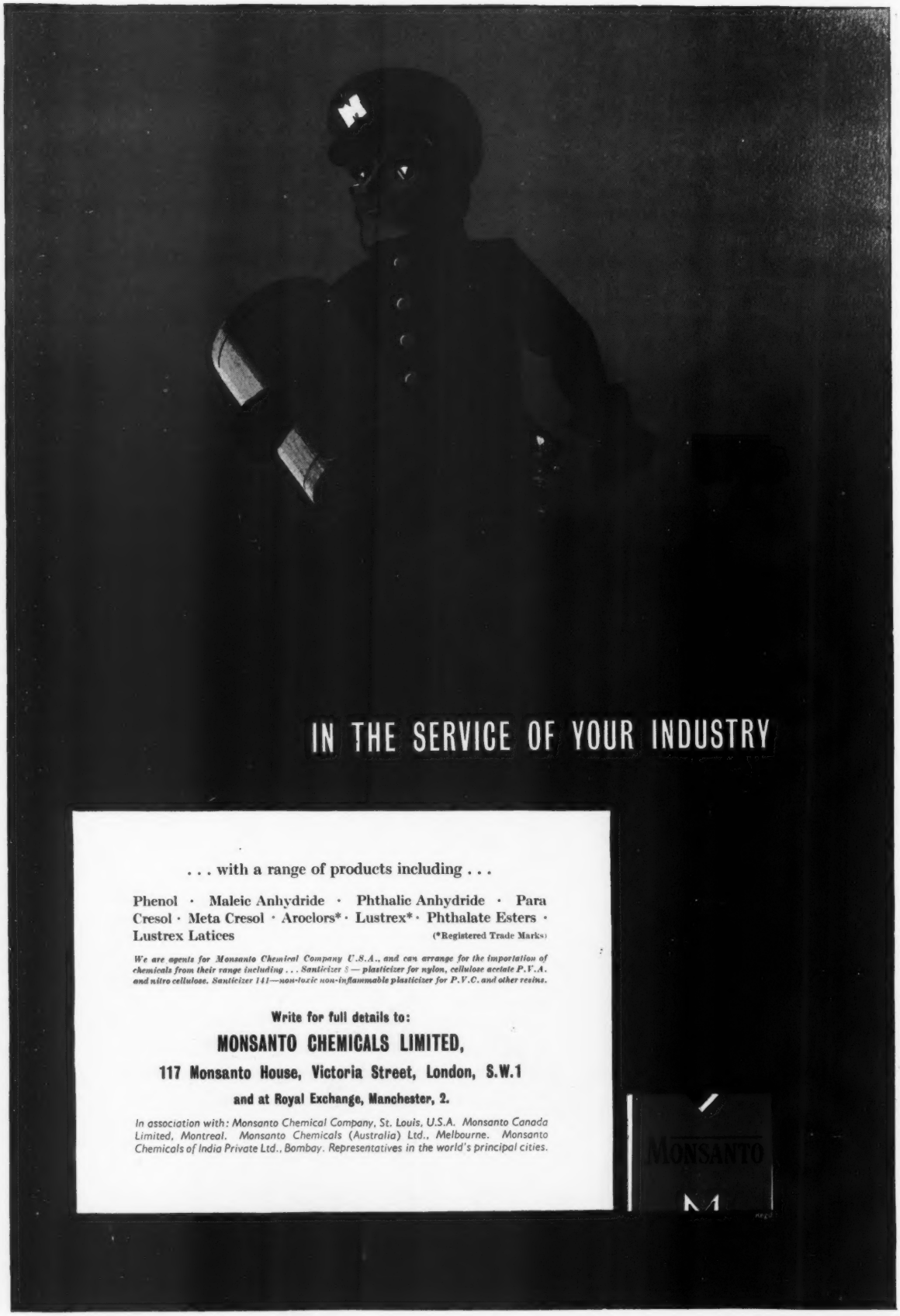
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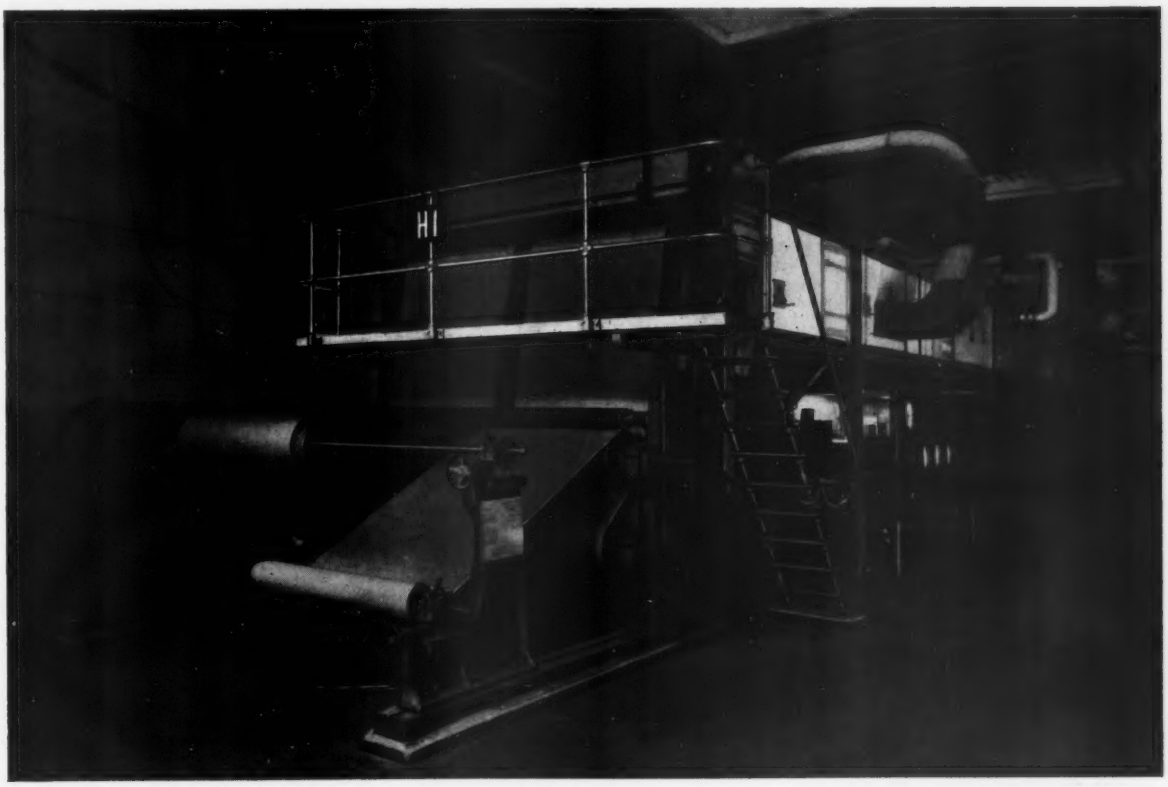

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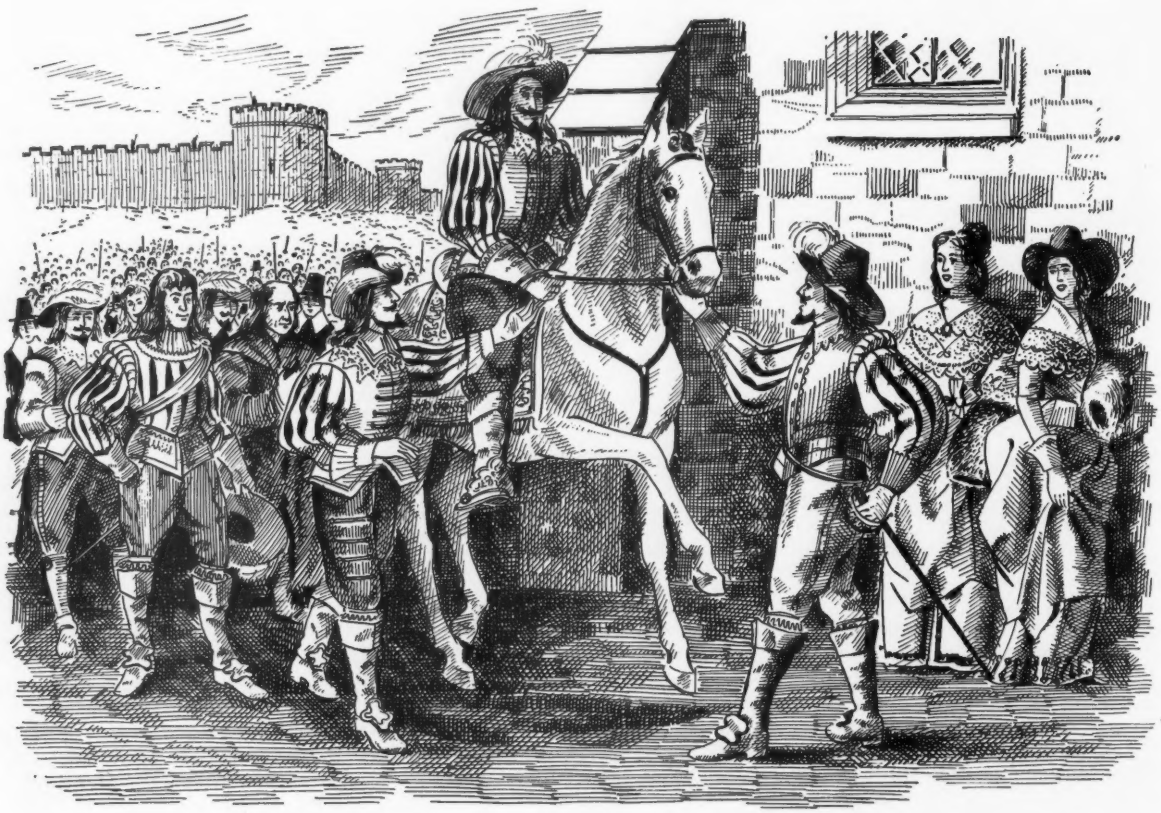
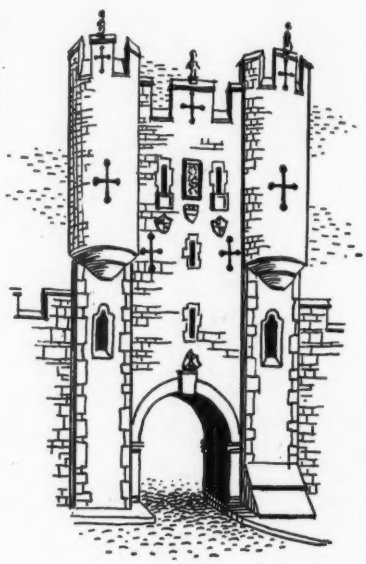


Sir Thomas Fairfax presents a petition to King Charles

Sir Thomas Fairfax, born at the Manor House at Denton in beautiful Wharfedale on January 17th, 1612, is one of Yorkshire's most famous sons, remembered for the part he played as one of Cromwell's generals in the Civil War. When King Charles addressed a great meeting outside York Sir Thomas succeeded in placing a petition on the King's saddle bow. This petition set out the tragic misery caused in Yorkshire by the King's excessive taxation to raise money for his war with France. The King's horse is reputed to have reared with fright when this incident took place.



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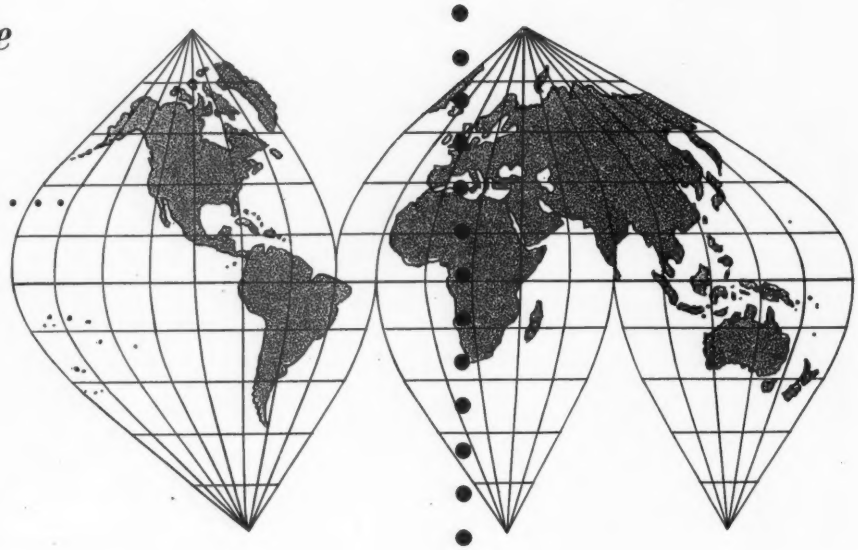

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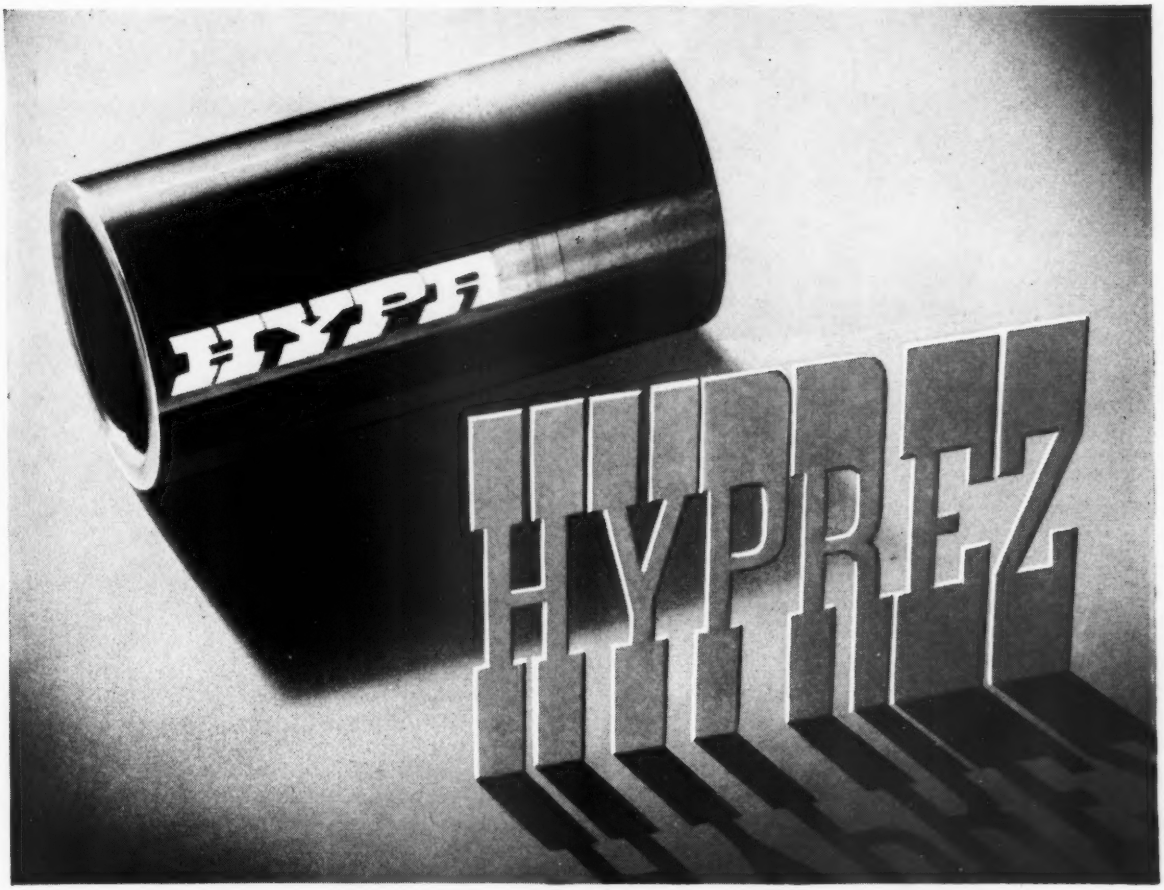
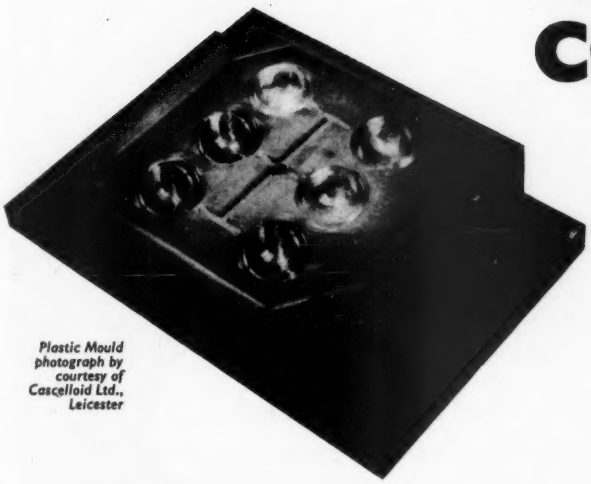


DIAMOND COMPOUND



Plastic Mould photograph by courtesy of Cascelloid Ltd., Leicester

imparts to plastic moulds a finish which is reflected in the product.

The illustration (left) shows a plastic mould part-finished with Hyprez, part-finished to a normal degree.

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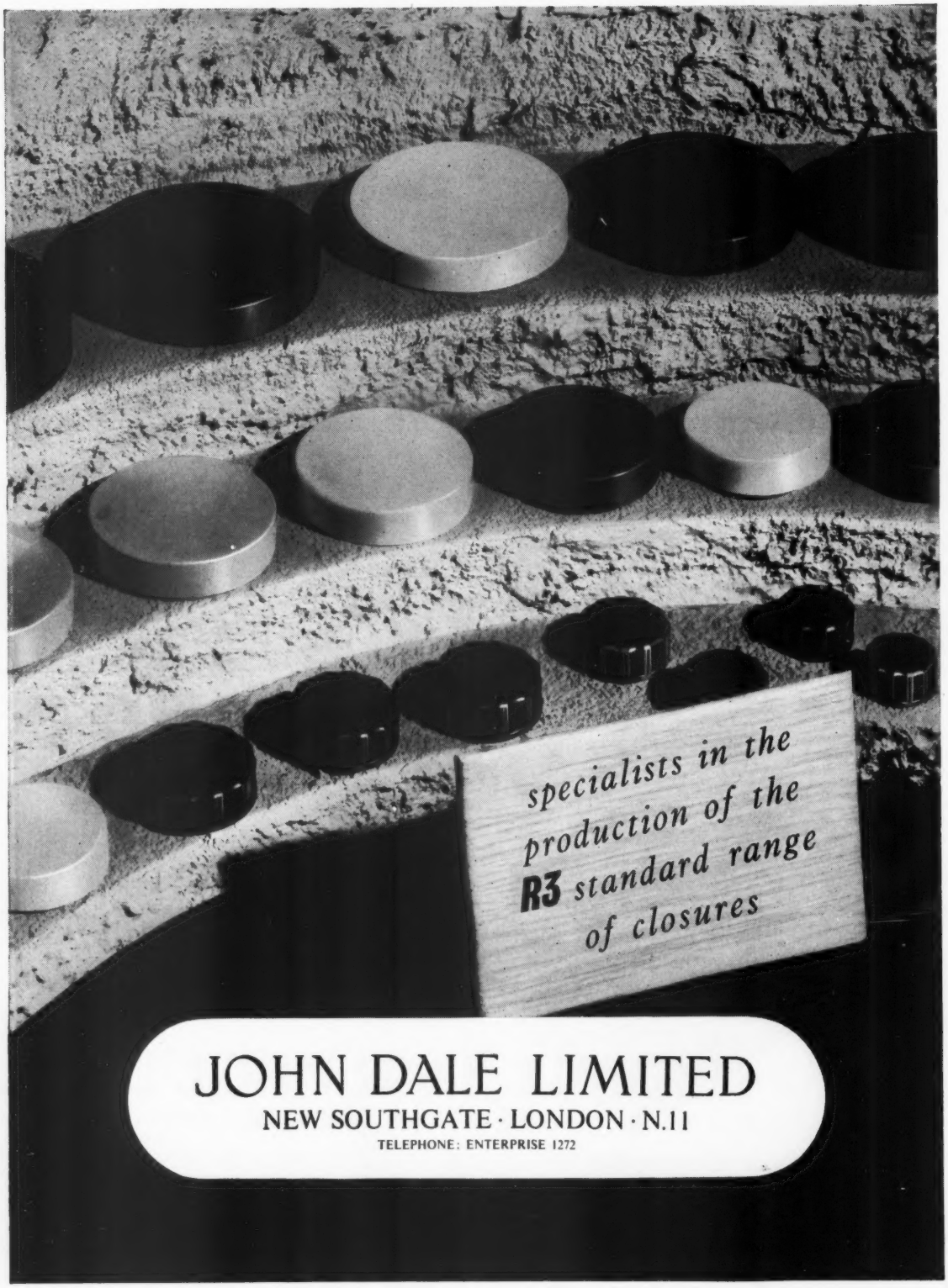
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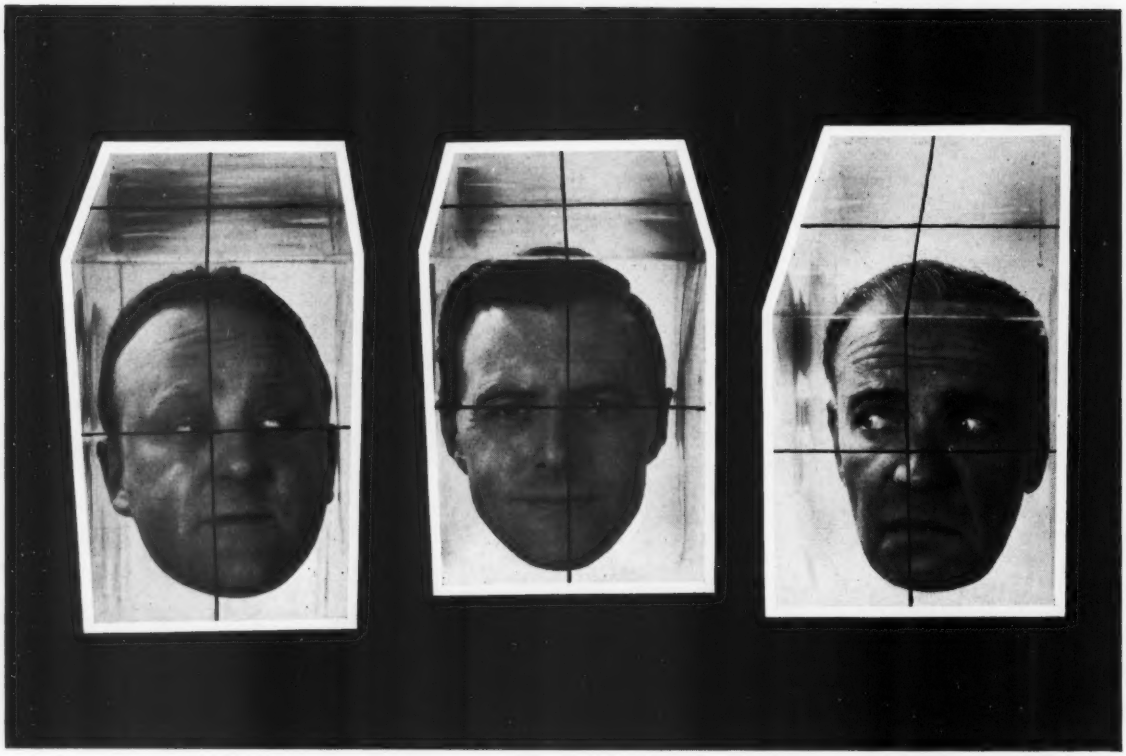

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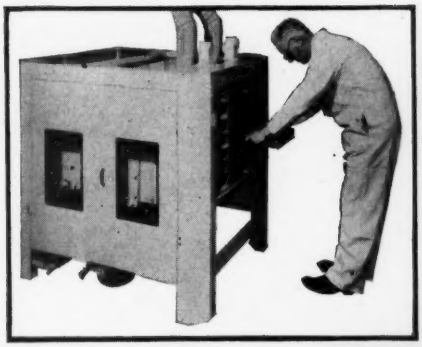

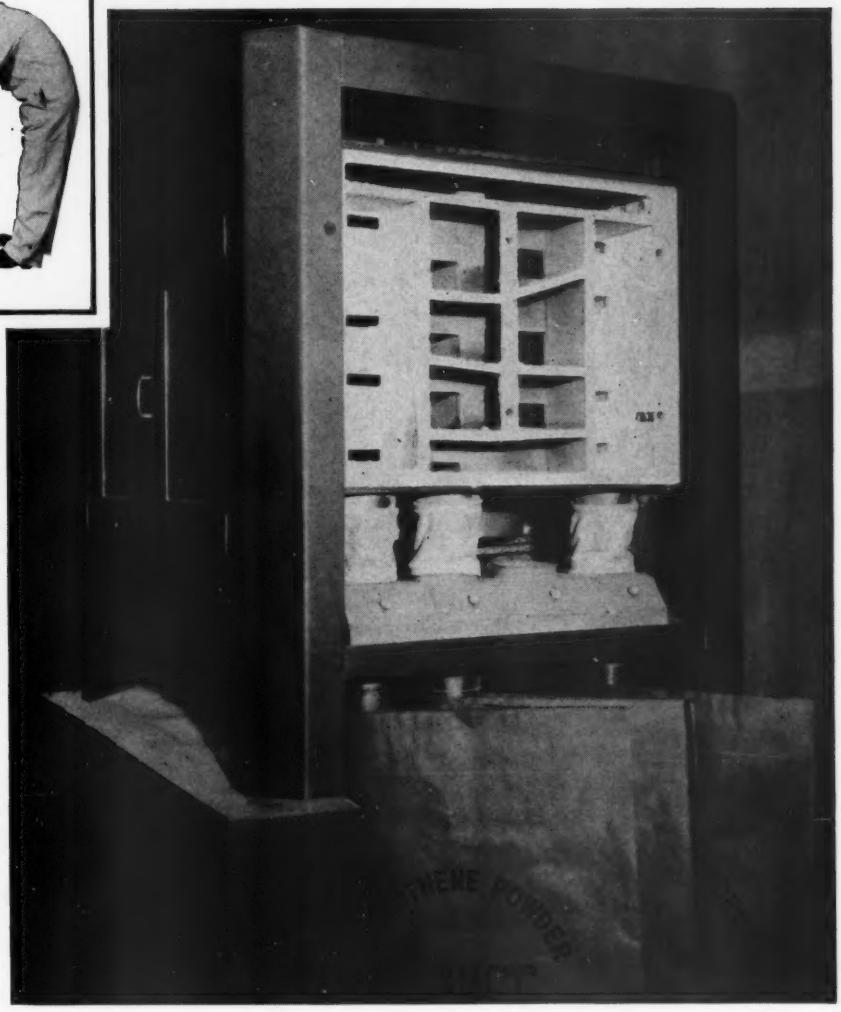

This Junior Sifter, installed at T. C. & M. Co. Ltd., has the side cover removed to show the internal sieving arrangement.

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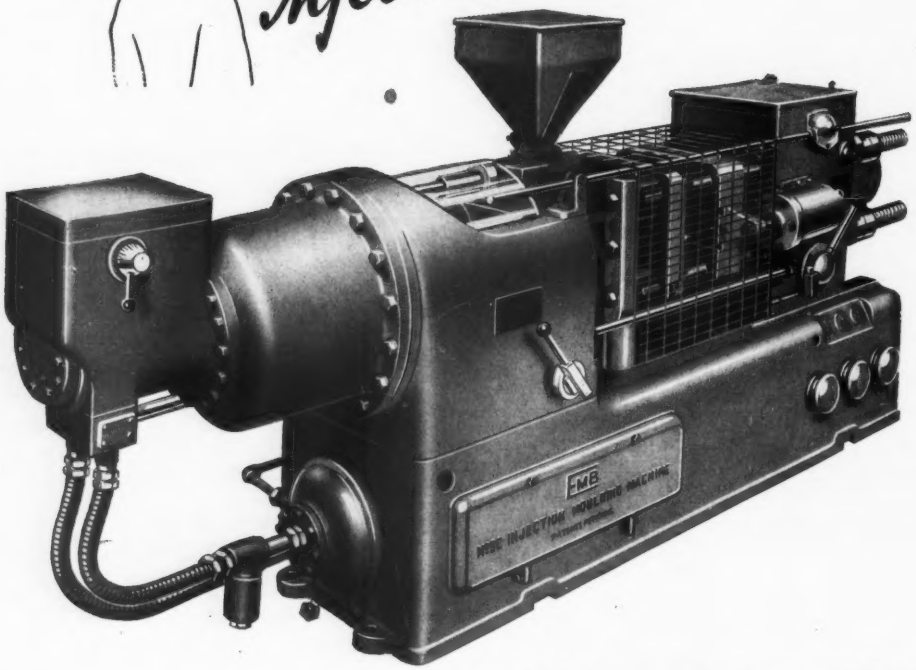

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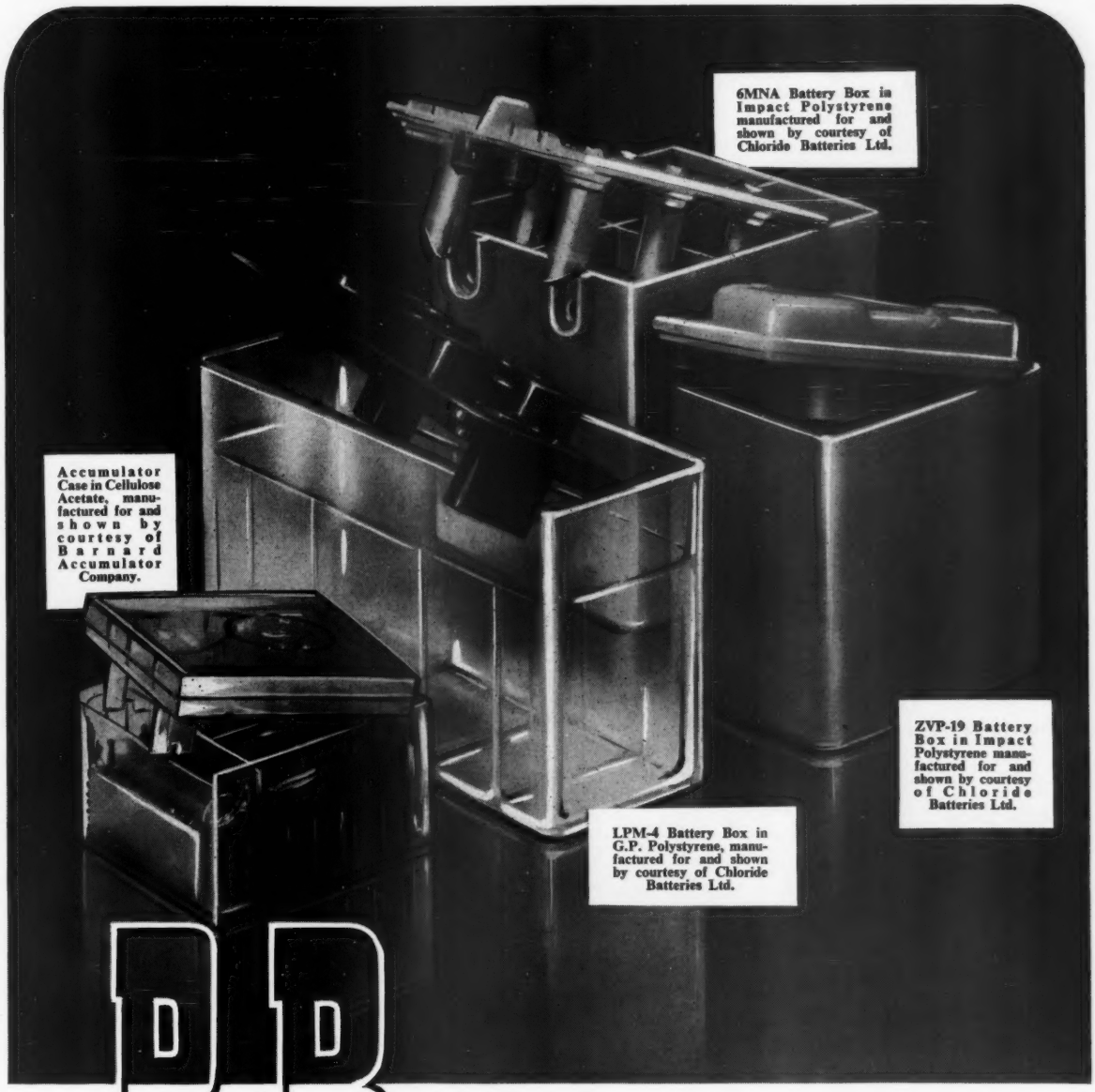

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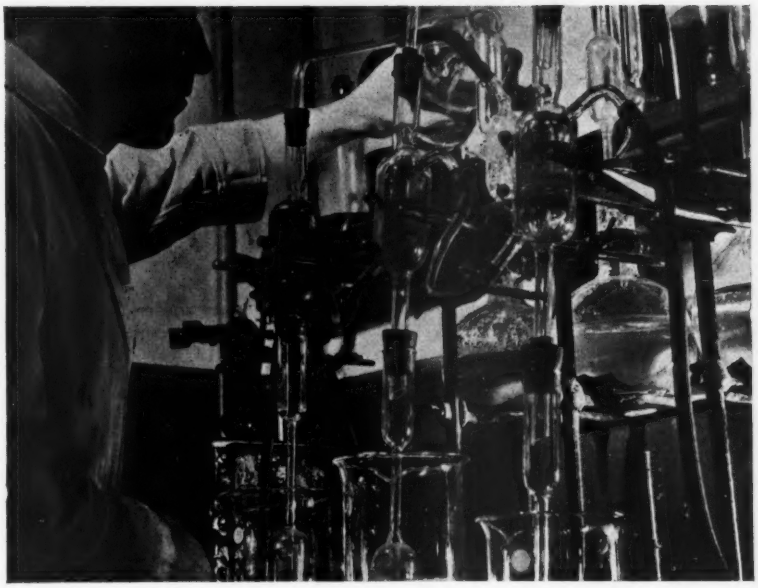

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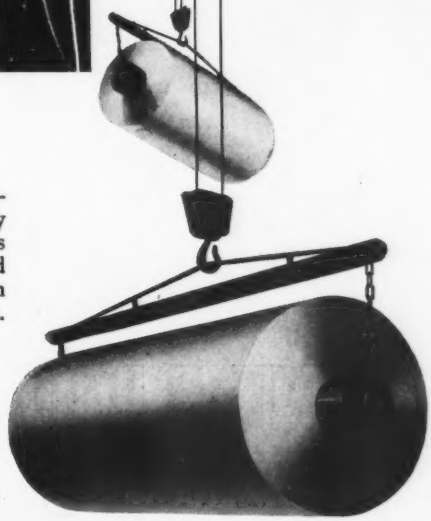

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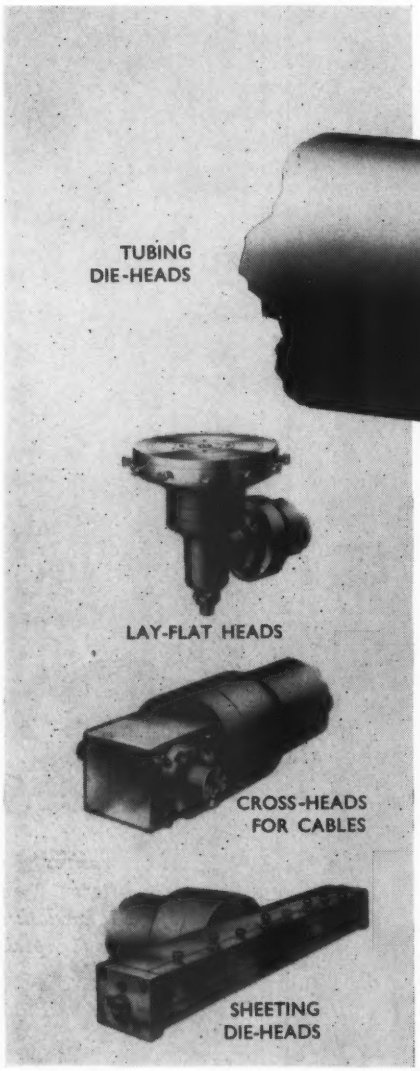

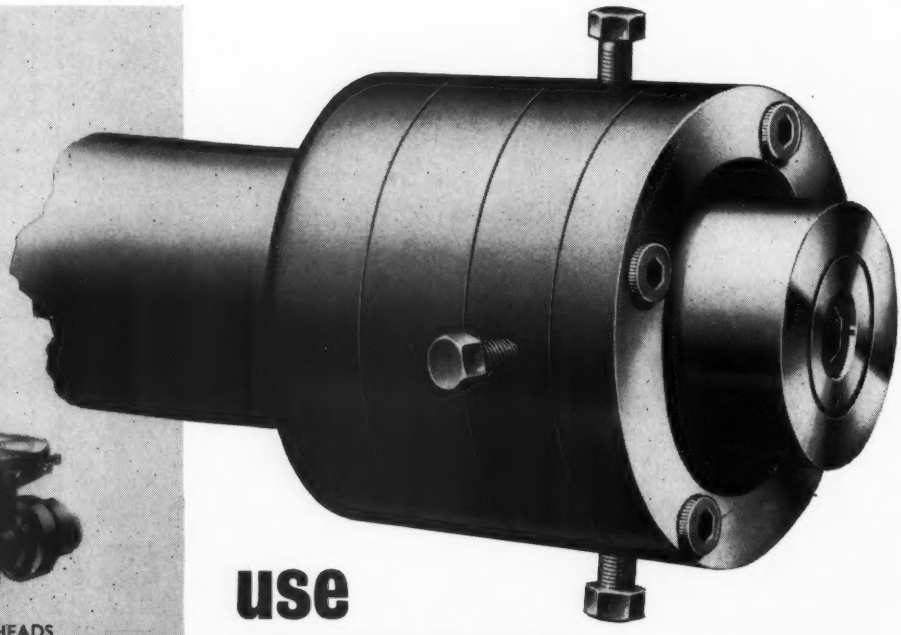

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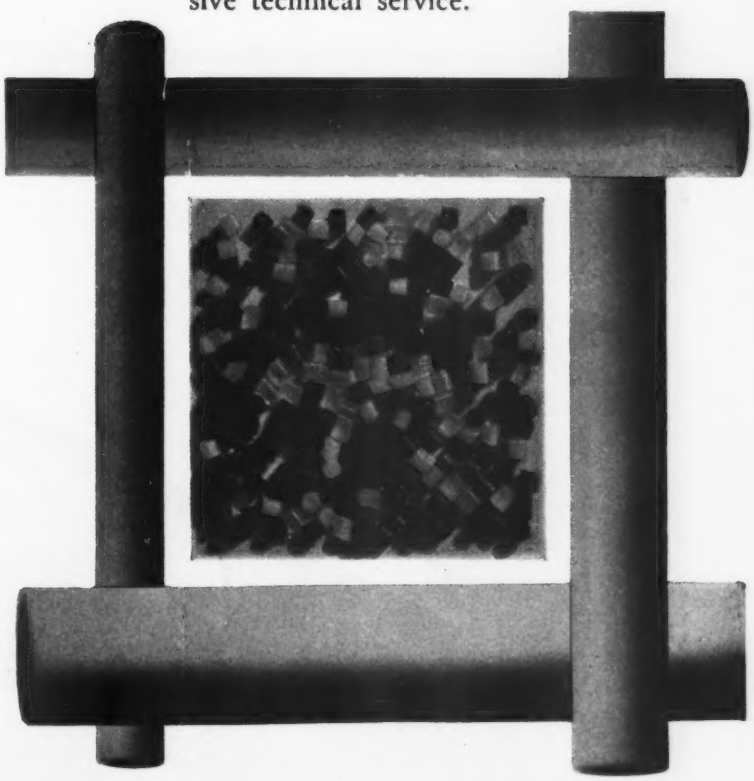

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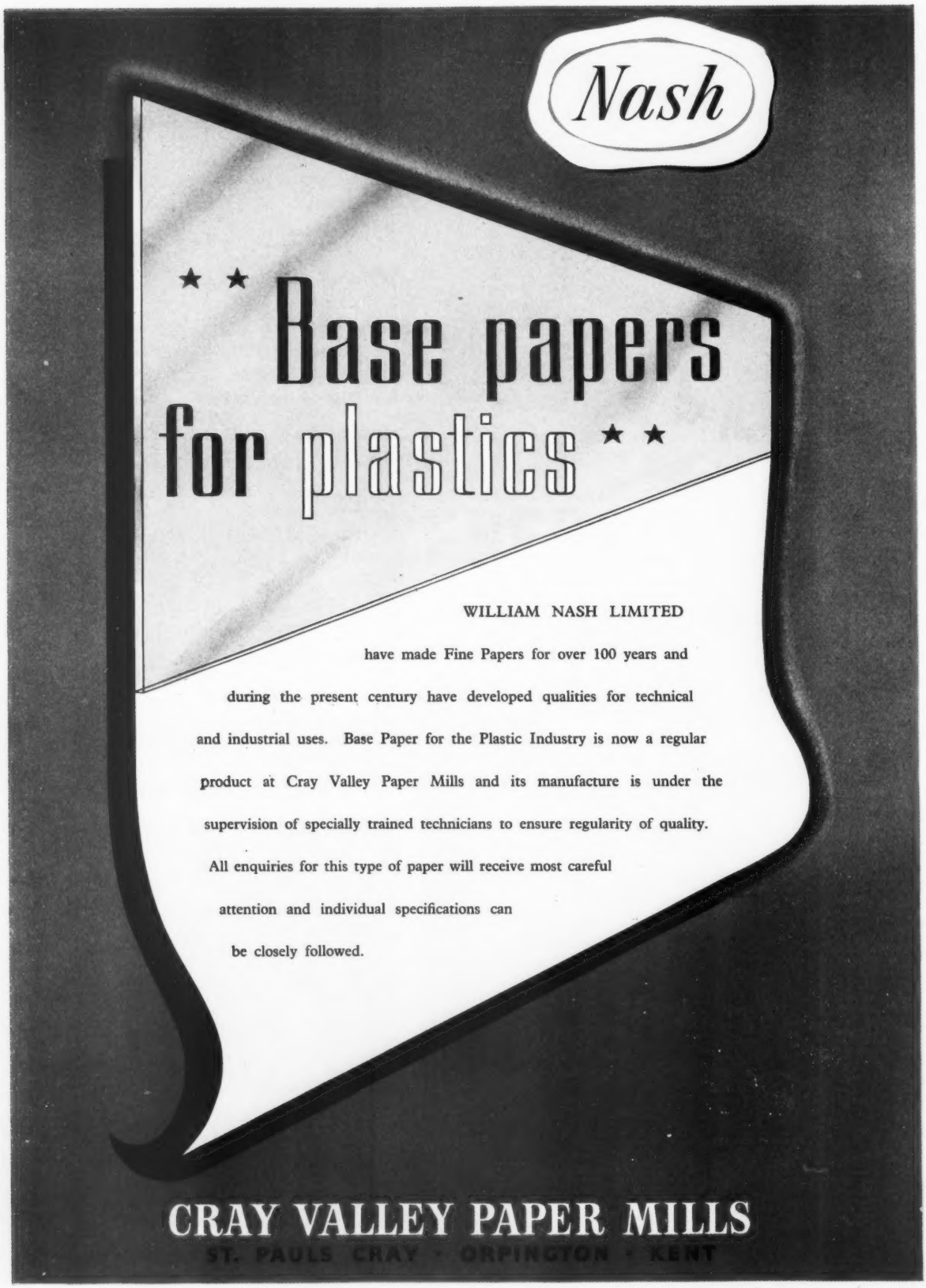
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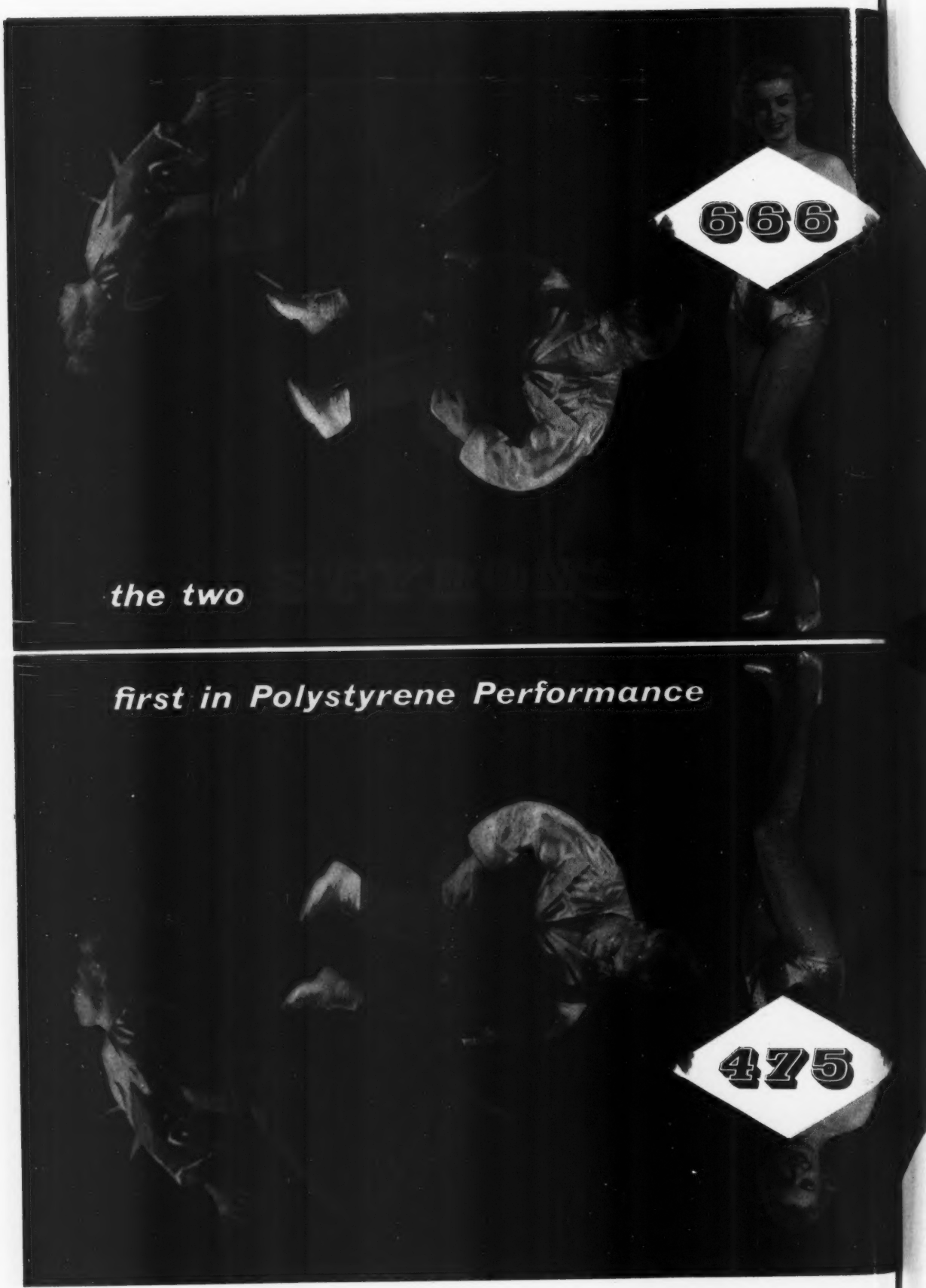
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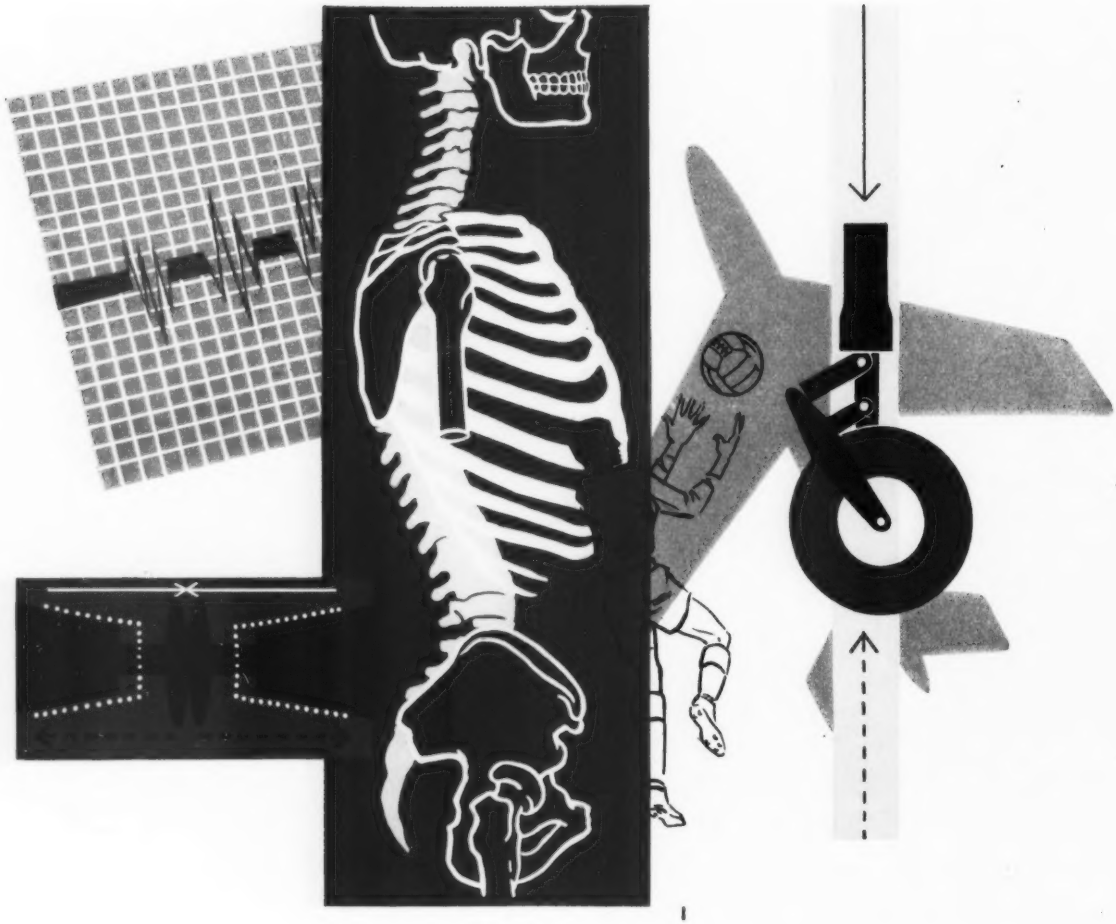

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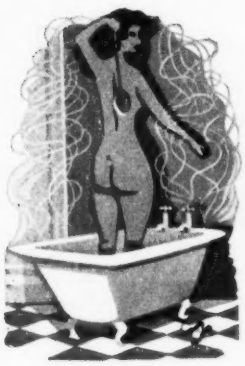

Between this girl's bath
and the wall
There used to be nothing
at all
Till a lively young lad
Thought: I've got it,
begad!
PVC would undoubtedly
make an effective,
economical, attractive and
easy-to-fit sealing-strip.

A motor designer from
Lancs
Gratefully murmured his
thanks
When a Lorival chap
After doffing his cap
Suggested that PVC
would make an effective,
economical and easy-to-fit
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Some limericks – from the

A fireman, talking aloud
Made this remark to the
crowd
Some boffin, I hear
Has a darned good idea
He says that PVC
would make a remarkably
effective, tough, durable
fire hose lining.

There once was a
Scotsman of Fife
Whose packaging
problems were rife
Until one day he spoke
To a Lorival bloke
Who said that PVC
sheeting would be an
effective, economical,
moisture-and-chemical-
proof answer to his
packaging problems.

lively lads at Lorival...

An electrical fellow
near Speke
Discovered a terrible
leak
But along came his
mate
At a helluva rate
Saying that Lorival
PVC would make an
effective, economical
insulating material for
all sorts of electrical
work.

PVC, in the hands of Lorival's lively lads, can do a lot of jobs better and cheaper. Why not drop a line to Lorival? Then you can get together with the lively lads and figure out ways and means of using PVC to your advantage.

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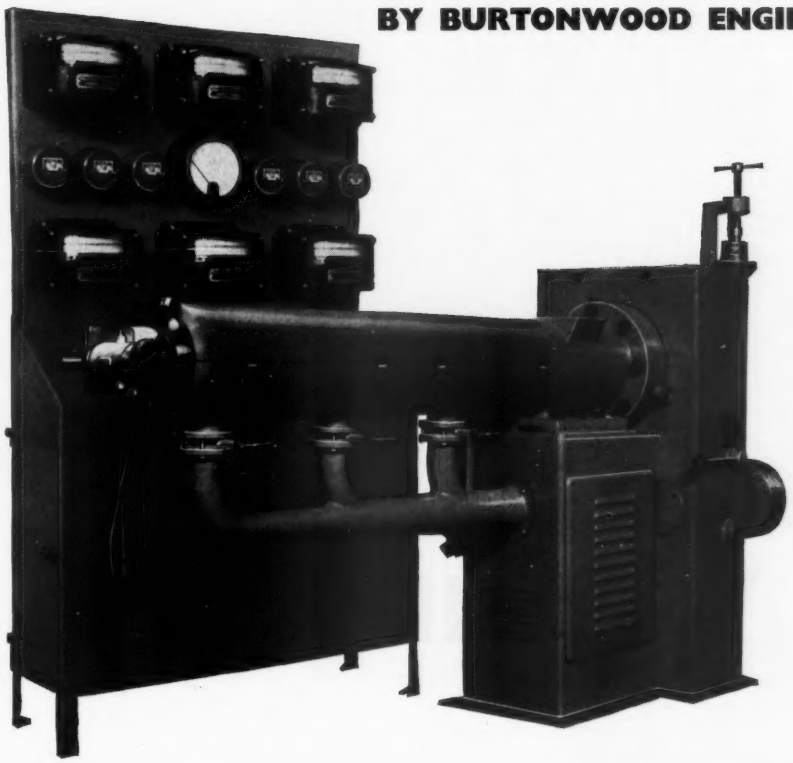

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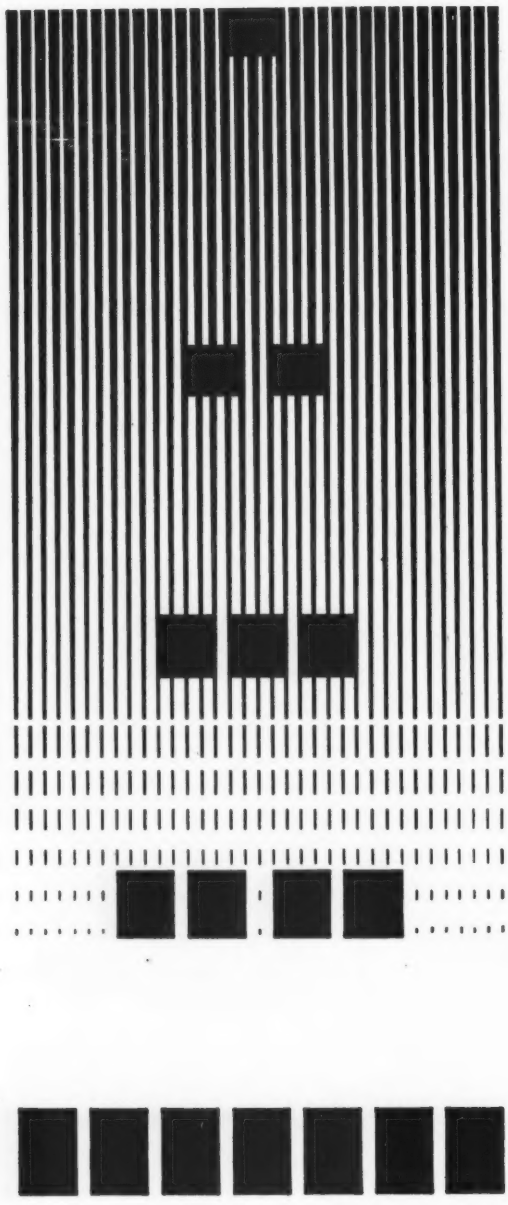

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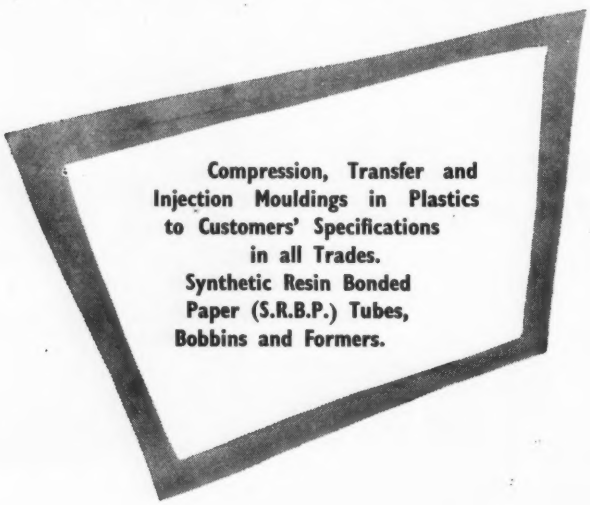
MOULDED PLASTICS



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57 years' experience at your service

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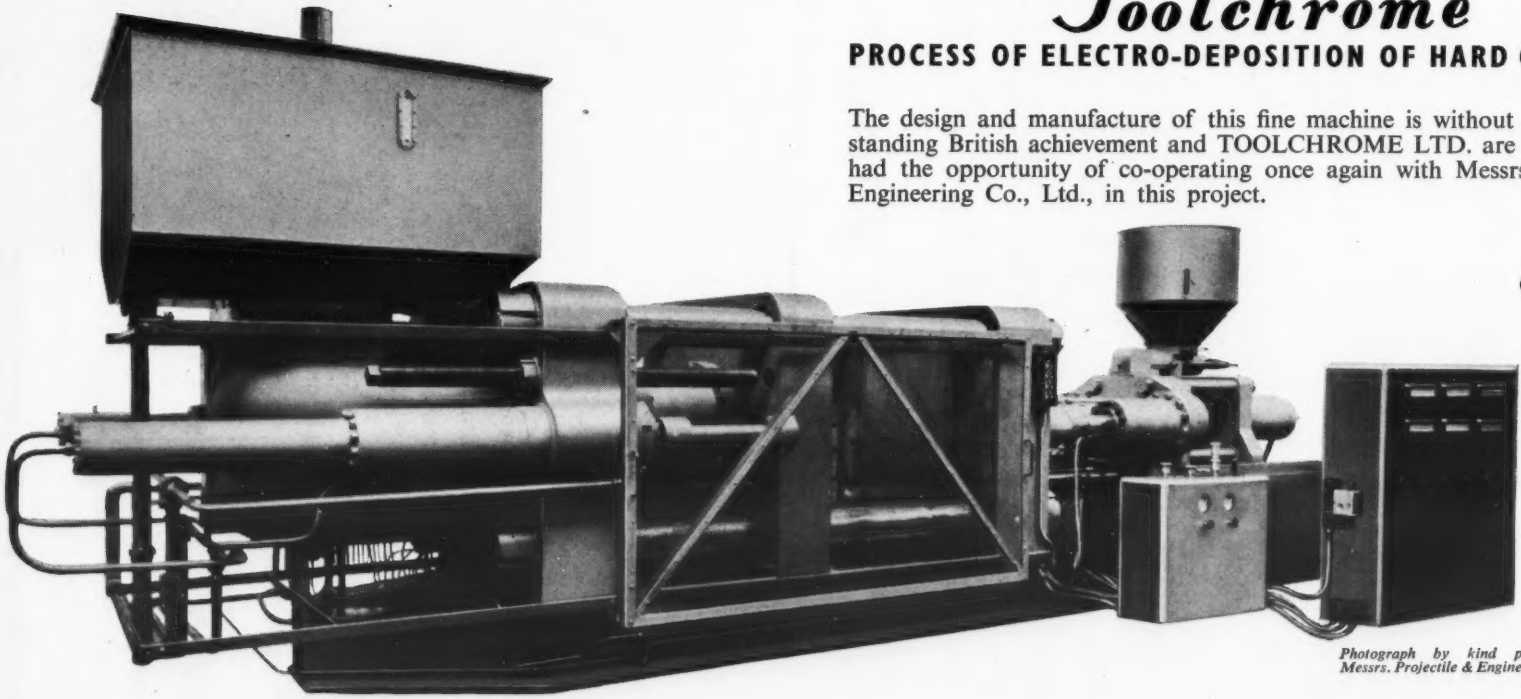
PROCESS OF ELECTRO-DEPOSITION OF HARD CHROMIUM

The design and manufacture of this fine machine is without doubt an outstanding British achievement and TOOLCHROME LTD. are proud to have had the opportunity of co-operating once again with Messrs. Projectile & Engineering Co., Ltd., in this project.



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ANNIS WORKS · ANNIS ROAD · HACKNEY · LONDON E.9 *phone* **AMHerst 2735**

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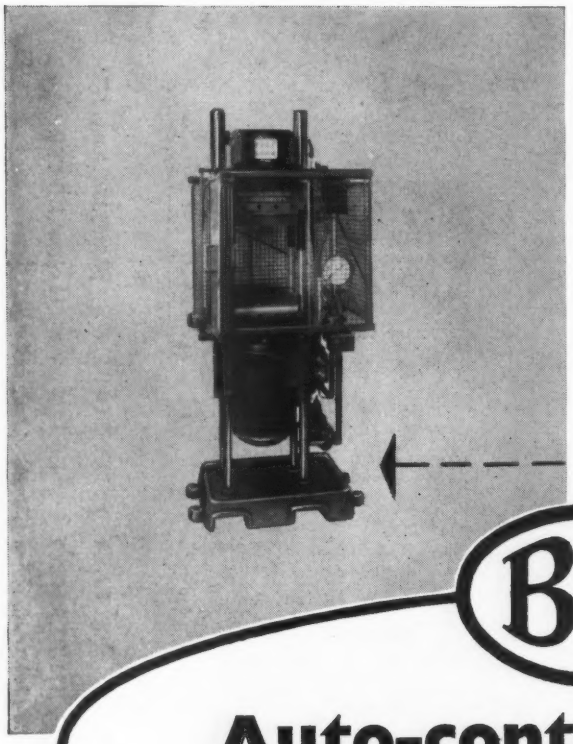
The Toolchrome Process is approved by the A.I.D. and A.R.B.



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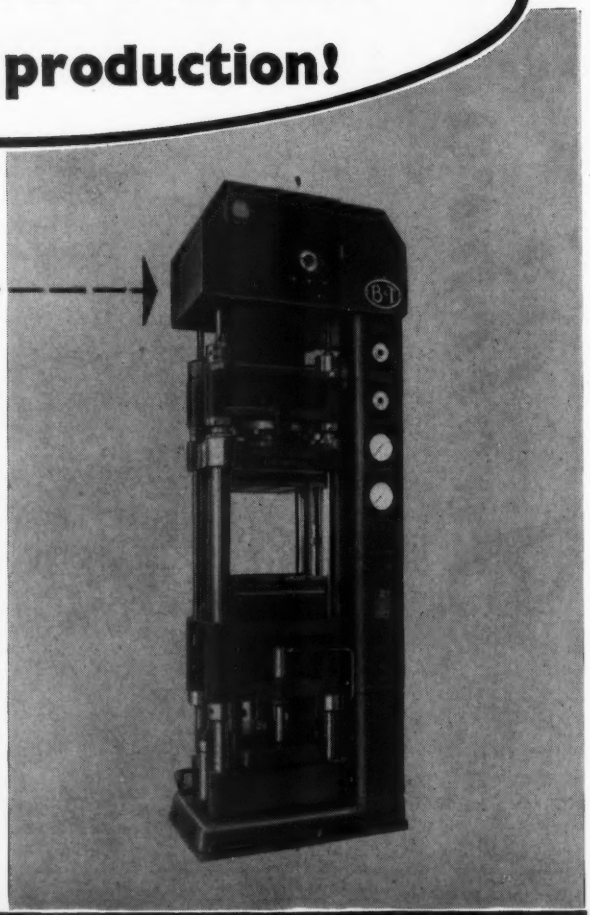
25 Ton Fast Cycling Upstroking Press, fitted with "easiest to set" controller for all compression cycles. Operated by push-button or by closing the operator guard.

B&T

Auto-control Presses for quality production!



No. 536 Type U/1

150/35 Ton Universal Compression and Transfer Press with Auto Cycle control to repeat any thermosetting moulding cycle including "breathing" and "dwell," automatically. Push-button start and automatic guard operation.

We shall be pleased to send full details on request.

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CALDWALL WORKS, KIDDERMINSTER

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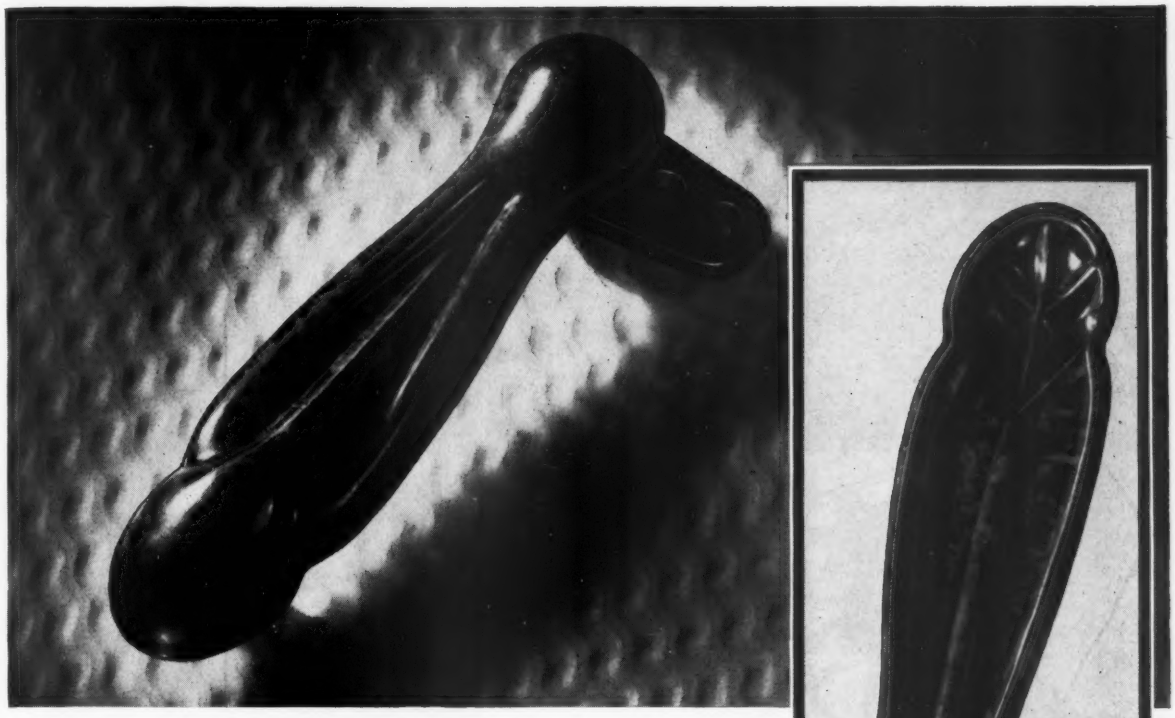

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There are many forms of stair carpet clips on the market but this particular one was doubly interesting to us. There was no doubt that in design alone it was a welcome and efficient departure from the all too familiar metal clip, and secondly it presented us with some interesting moulding problems.

This clip was designed to give strength with lightness and had to be moulded within a definite price range. Large quantities were required and two twelve impression semi-automatic compression moulds were needed to meet this demand.

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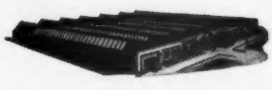
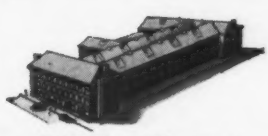


Walsall Works (Bescott Crescent)

Victoria Works (Summer Lane)



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If you produce anything that involves fixing one part to another we should like to make you an offer. Here it is: send us a sample of the article you make. Our Product Survey Department will take it to pieces and reassemble it using Spire Speed Nuts, Screws and Clips. Your product will then be returned with an illustrated Fastening Analysis, showing what you would save in time and money by assembling with Spire Fasteners. THIS TECHNICAL SERVICE IS FREE OF CHARGE. If you're interested (and you should be!), drop us a line and we'll send you full details—or call in our Technical Representative, he's a fastening specialist.

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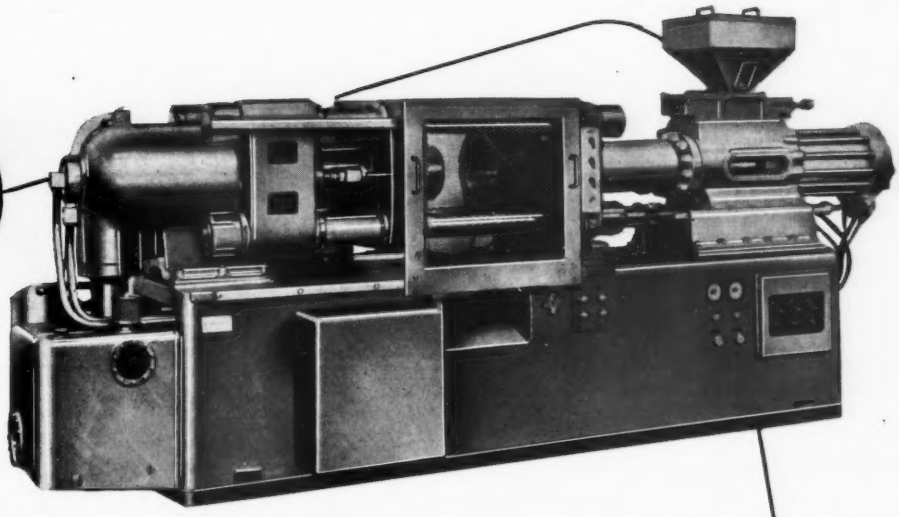
INJECTION MOULDING PRESSES



These machines mean BUSINESS for you

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All « NB » presses, like the NB. 360/520 shown here (12-19 oz.) are self-contained with the oildynamic power drive unit incorporated into the machines. The progressive electric system, featured by all « NB » presses, makes operation simplicity itself and cuts maintenance to a minimum. Main components are easily interchangeable. All machines are fitted with safety devices.

Injection presses "RAPID,, full automatic

NB & Co. are leading in automation of plastics equipment and are mass-producing the « Rapid » 1-2-4-6 ounce models, which operate by themselves on fully automatic fast cycling.

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« NB » single-screw extruders are available in « Standard » models with 30-45-60 mm. screw diameters; in the « TV » series, with built-in speed variator, with 45-60-70 and 90 mm. screw diameters. Screws and die heads are available in a wide variety of designs for all sorts of extrusion jobs such as: tubing, profiles, wire coating, monofilaments, and are completed by full equipments for the extrusion and blowing of P.V.C. and Polyethylene tubular films.

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VUOTOPLAST VACUUM FORMING

"VUOTOPLAST,, Vacuum Forming

Here is something really sensational !
« NB & Co. » introduce vacuum formers with patented movable and adjustable infra-red heater elements, that concentrate heat where it is most needed, thus ensuring constant cross-sections throughout the formed pieces and permitting extremely deep draws.
« Negri Bossi & Co. » build both, automatically operated machines as well as cheaper « Standard » models that, however, still maintain a high productivity level.

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MILANO (ITALY)
44, CORSO MAGENTA
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Scott Bader have been manufacturing polyester resins for 10 years, and during this time an unrivalled reputation has been achieved for consistency, prompt delivery and sound technical service.

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Crystic 191	the most widely used polyester for general moulding work, commercial vehicles, caravans, etc.
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Over 50 other **Scott Bader** polyester resins and ancillary products are also available.

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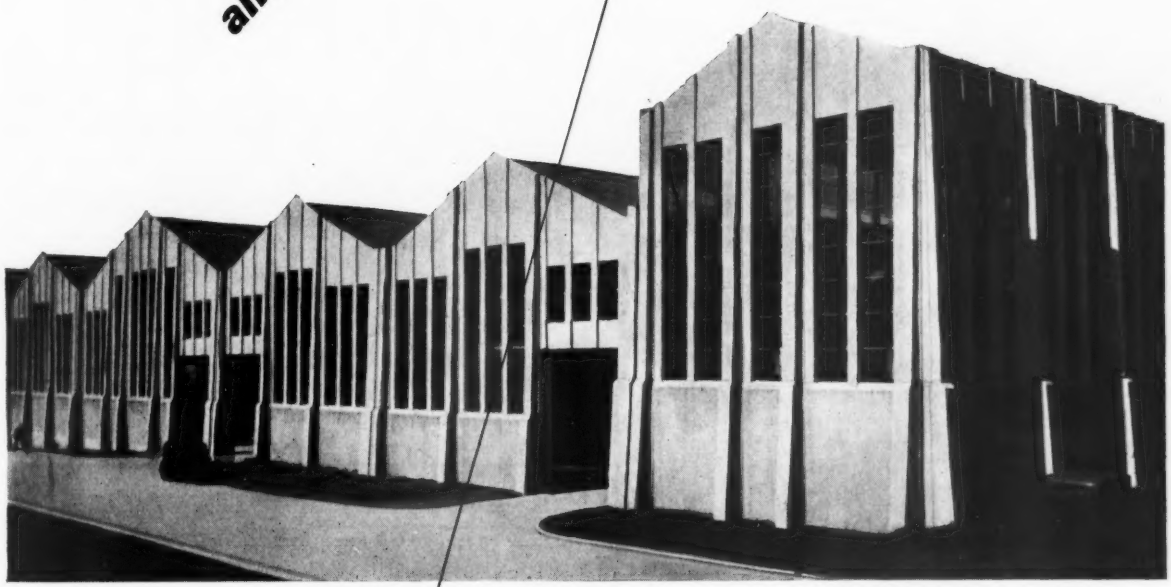

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The Four-Minute Mile . . . the Mach 2 fighter . . . in every department of contemporary living the slowest of us, the most disorganized, run harder merely to hold position.

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Beecham Buildings offer *new ways*. By keeping every function, from initial survey to final finishing, under one overall control, Beechams work to production schedules and completion dates which mean exactly what they say. Construction is speeded, maintained at the highest standard, and costs are cut.

By emphasizing the real, and hitherto little-exploited, contribution that planned factory production can make, site delays are largely avoided. Construction is speeded and the client's capital is put to work for him much earlier.

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The number of men who can operate precision toolroom machines must run into many thousands. This man is one of them, but he is a machinist with a difference—for he is one of the Craftsmen of Tyburn Road; the most exacting standards are expected of him and he can satisfy those standards only because, in addition to operating skill, he has behind him an intimate knowledge of the art of mould-making, acquired during many years' continuous service.

To endeavour to build a tradition in a young industry during uncertain times is, indeed, a formidable task. Yet that is what has been achieved and will always remain the cornerstone of this model Toolmaking Unit. Stringent standards, careful selection and training of staff, and, especially, those working conditions which ensure continuity of service—these are all reflected in the precision and perfection of finish of every tool made by . . .

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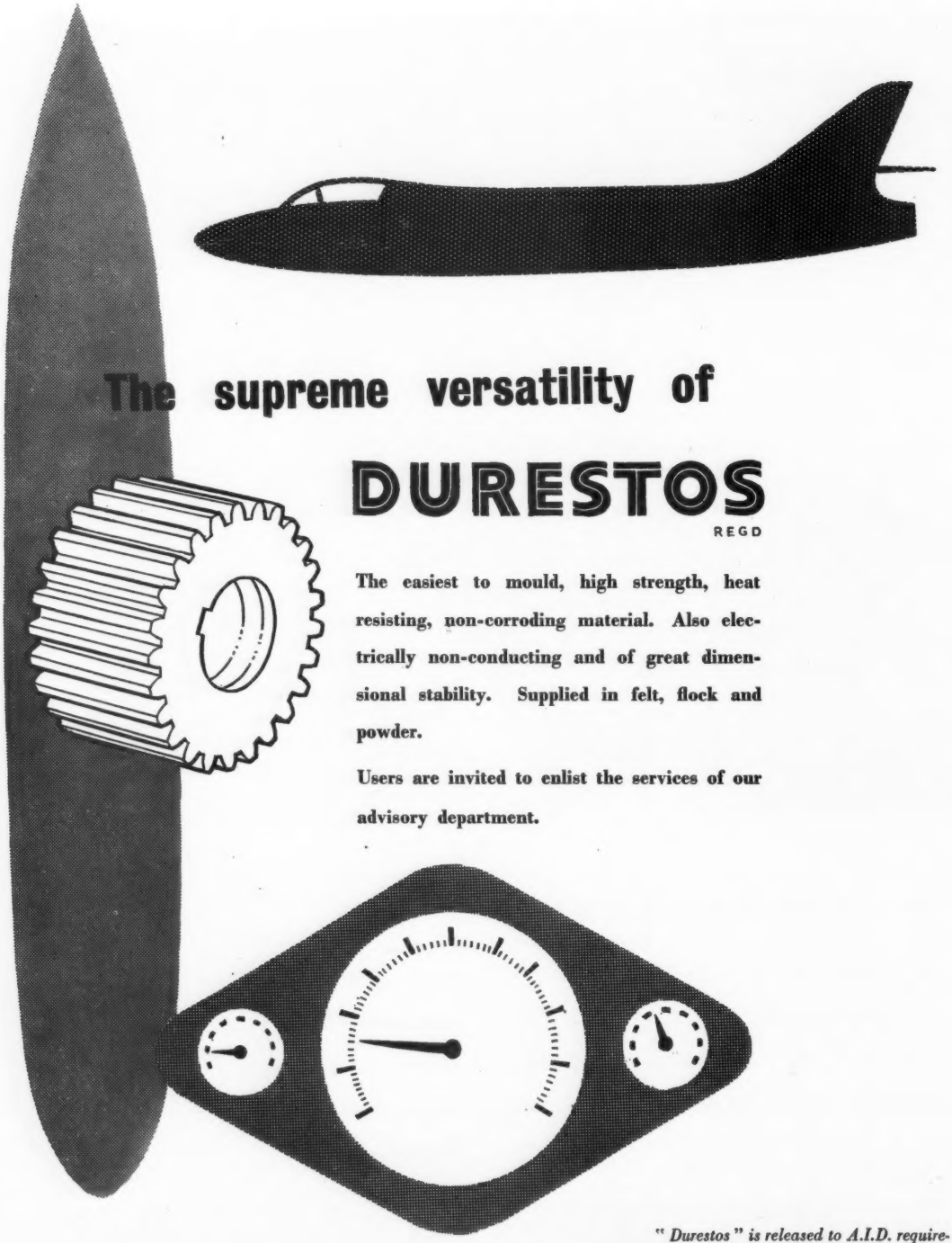

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The easiest to mould, high strength, heat resisting, non-corroding material. Also electrically non-conducting and of great dimensional stability. Supplied in felt, flock and powder.

Users are invited to enlist the services of our advisory department.

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Introducing the new triple-screw Universal Compounder for the continuous production of Thermoplastic Compounds

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COMPRESSION AND INJECTION MOULDING

For Compression Moulding we offer a wide range of **Daniels** Presses including Upstroke Machines up to 150 tons ; Down-stroke and Transfer Machines up to 500 tons ; Side Ram Machines up to 150/75 tons ; Low-Pressure Machines, two sizes, 100 and 250 tons ; Hobbing Presses, two sizes, 500 and 1,000 tons and Preforming Machines for moulding tablets up to 1½" diameter.

For Injection Moulding we can supply the **Herbert/Reed-Prentice** Machines, Manual, Semi- or Fully-automatic in operation. Double-Shot Mechanism is fitted to increase capacity by double packing.

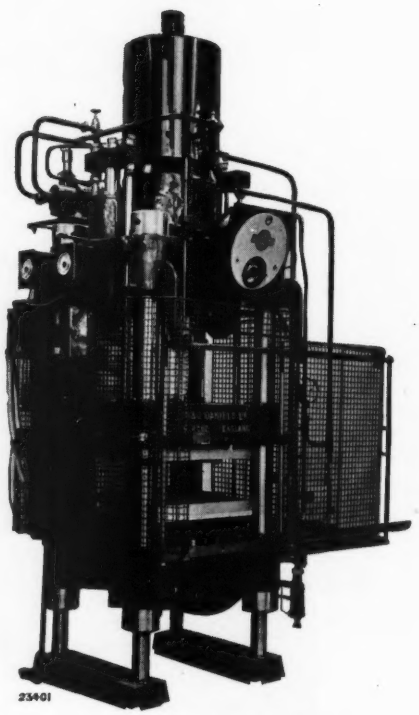
Available in the following sizes:—

	175T	10D	400T
Moulding Capacities ...	4–6 oz.	8–14 oz.	16–22 oz.
Locking Pressure ...	175 tons	250 tons	400 tons

The **Edgwick** "HY" is offered with either semi- or fully-automatic operation and 1½ oz. capacity. Double-Shot Mechanism can be fitted.

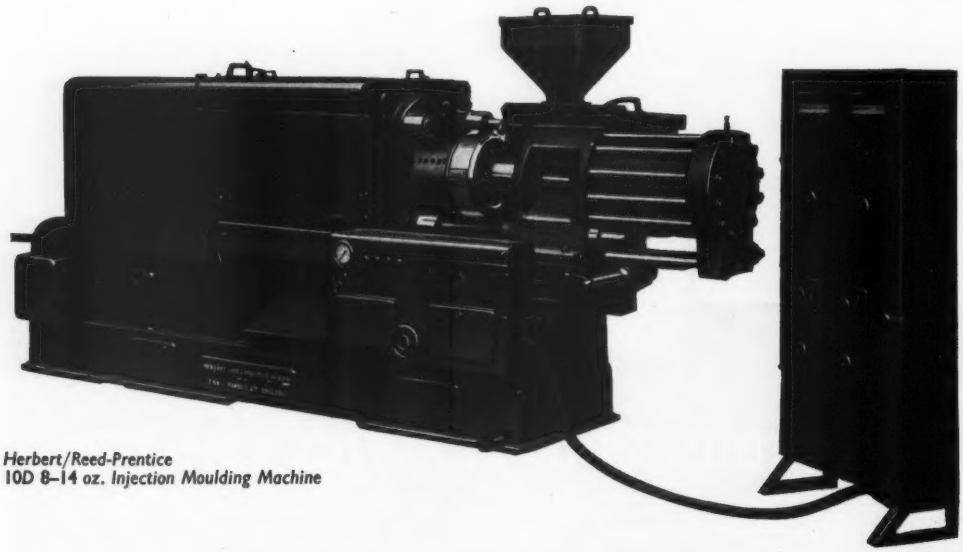
Pulsometer Vacuum-forming Machine, available in single and twin types to handle plastic sheet up to 26" and 36" square respectively, and Drape-forming Machines. **Osborn** Automatic Weighing Machine for fitting to all types of Injection Moulding Machines to eliminate powder wastage.

Most of the Injection Moulding Machines can be seen in our Showroom at Coventry which is staffed with specialists to give expert advice.



23401

Daniels 150 ton Down-stroke Press



Herbert/Reed-Prentice
10D 8–14 oz. Injection Moulding Machine

AD129

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S.P. STRUCTURAL PLASTICS LTD.

Eythorne, Dover, Kent

Directors: L. Pears, M.Sc., Ph.D., R. Sheridan, B. P. Sheridan, B.Sc.

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MANUFACTURERS OF REINFORCED LAMINATES AND MOULDINGS

YOUR REF: GBJ/JFA OUR REF: RS/SU/ML DATE: 24th May, 1956.

Messrs. James Beadel & Co. Ltd.,
110, Cannon Street,
LONDON, E.C.4.

Dear Sirs,

We thank you for your letter of the 23rd May with regard to the question of fire retardant resin and note your remarks with interest. By a remarkable coincidence we have received a letter to-day from a firm of builders' merchants to whom we supplied corrugated translucent sheeting made with your Filabond 1345 Resin, advising us that some of these sheets which were installed in a shop in Weston-Super-Mare were involved in a fire on the premises during Whitsun. The shopkeeper reports that the fire our "Rufelite" sheeting helped to hold back the spread of flames and he is therefore very keen on the product.

This undoubtedly answers the question of fire resistance which we had been discussing with you and we feel you will agree that one eventuality of this nature is worth a good deal of abstract laboratory investigations.

Yours faithfully,
S.P.Structural Plastics Ltd.

R. Sheridan

Director.

filabond polyester resins

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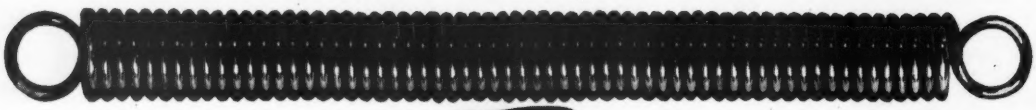
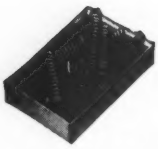
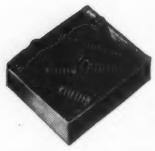


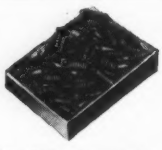


No. 760. 3 doz. Assorted Light Compression Springs 1″ to 4″ long, 22 to 18 S.W.G., ¼″ to ½″ diam. 6/6 each.

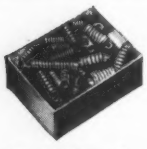


No. 98A. 3 doz. Assorted 1″ to 4″ long, ¼″ to ½″ diam., 19G to 15G. 5/6 each.

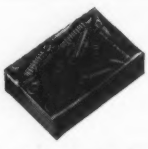
No. 757. Extra Light Compression, 1 gross assorted, ⅛″ to ¾″, ¼″ to 2″ long, 27 to 20 S.W.G. 15/- each.



No. 388. ¼ gross Assorted Small Expansion Springs. ⅜″ to 1¼″, 18G to 21G. 9/6 each.



No. 758. Fine Expansion Springs. 1 gross Assorted ⅛″ to ⅜″, ¼″ to 2″ long, 27 to 20 S.W.G. 15/- each.



No. 466. ¼ gross Assorted Small Expansion Springs ⅜″ to 1½″ long, 3/32″ to 3/16″ diam., 21G to 24G. 6/6 each.

No. 1013. 1 gross Small Coil Compression Springs, ⅜″ to 1¼″ long, 3/32″ to $\frac{7}{16}$″ diam., 24G to 19G. 6/- each.

No. 753. 3 doz. Assorted Light Expansion ¼″ to ½″ diam., 2″ to 6″ long, 22 to 18 S.W.G. 10/6 each.

No. 1024. 20 Compression Springs 12″ long. ½″ to ¾″ diam., 24G to 18 G, suitable for cutting into shorter lengths; and 30 Expansions 1½″ to 12″ long, 5/32″ to ½″ diam., 22G to 16G. 24/- each.

How are you off for Springs?

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These Boxes of Springs can also be obtained at:

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The prices quoted are subject to the usual trade discount.

HERBERT TERRY & SONS LTD. REDDITCH, WORCS · SPRING MAKERS FOR 100 YEARS

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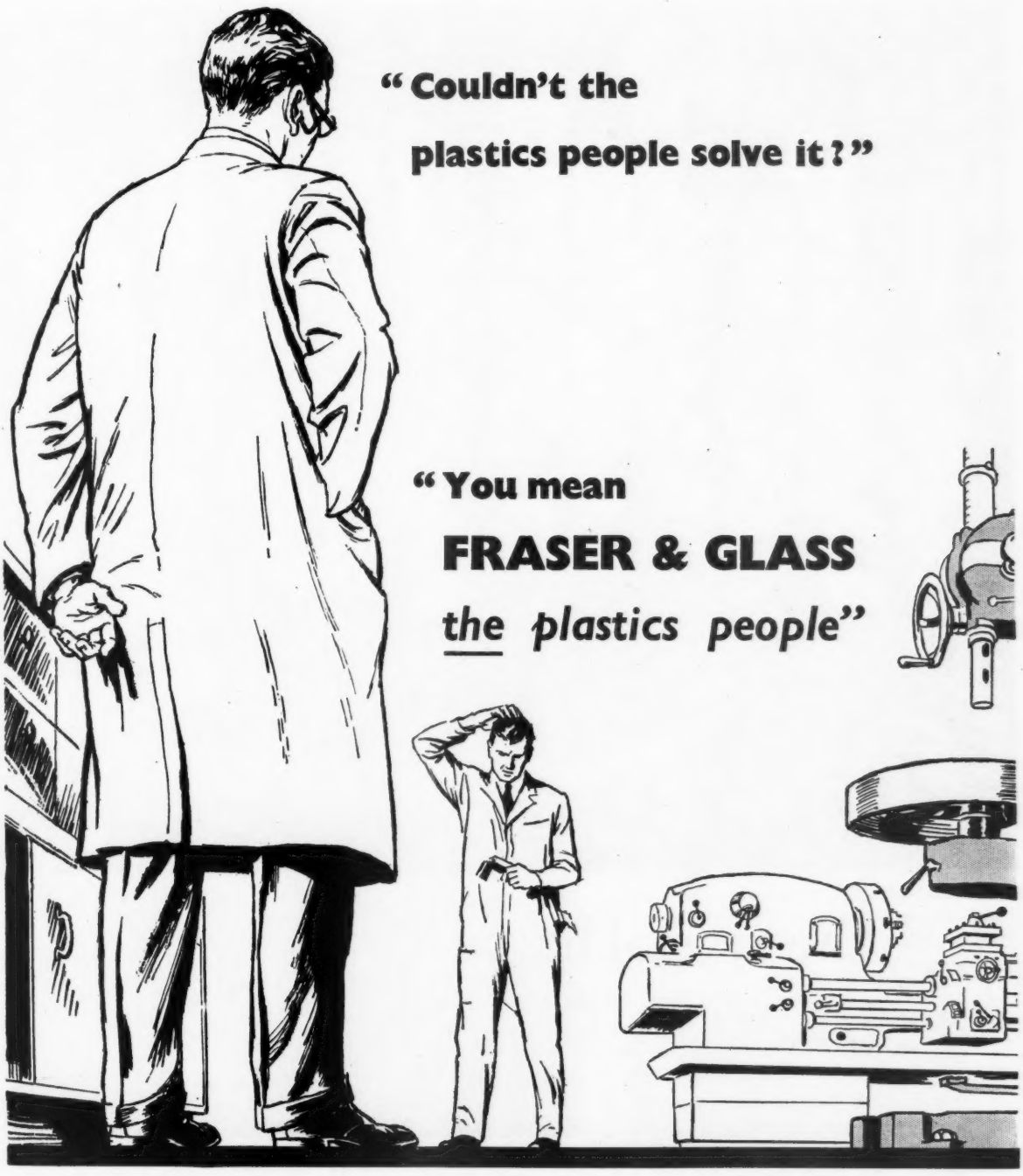
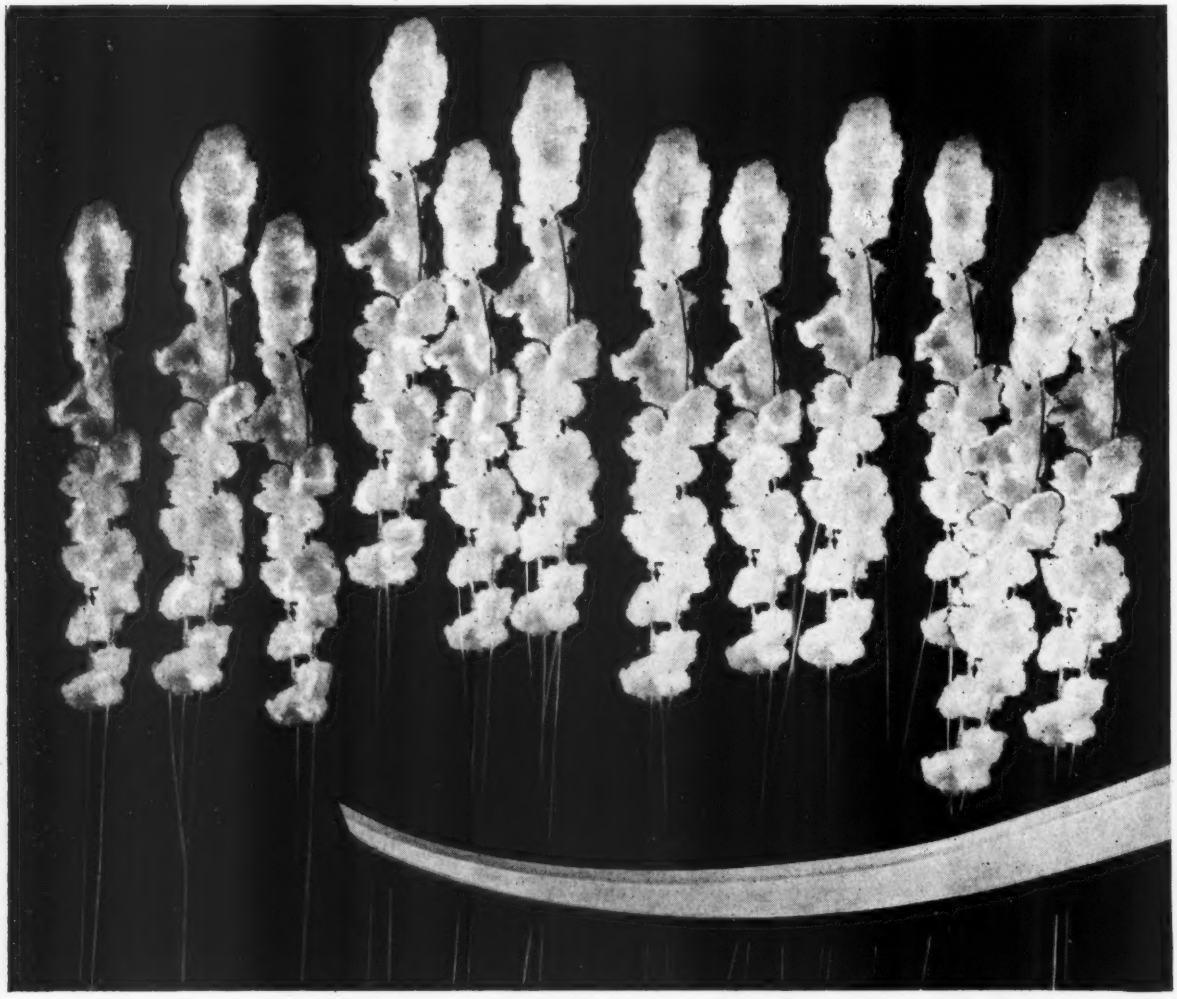


Whether your problem is an intricate high precision component which has to resist heat, corrosives, shock loads, electrical discharges and the rest, or a display pack which simply needs to look attractive—a plastic moulding may be the answer. And if plastics can help, Fraser & Glass are the people to see. They have the know-how on plastics materials and the facilities for high speed injection and compression moulding, together with the skill to ensure success. During the last 30 years, Fraser & Glass have solved countless manufacturing problems and often, they've saved manufacturer's money! If you've a problem where you think plastics might help, *ask Fraser & Glass!*

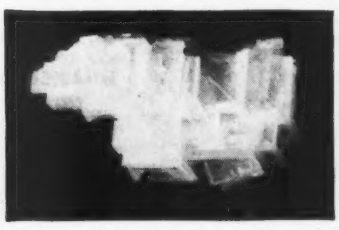
FRASER & GLASS LIMITED,
WOODSIDE LANE, LONDON, N.12
HILLSIDE, 2224-5



the crystal harvest

Not on tall straws is borne the fruit of harvest here at Whiffens — but on a slender string! For, in these parts, crystals are the main crop and the best are grown on strings. Potassium Bromide crystals, Potassium Iodide crystals — crystals of exceptional quality to serve the pharmaceutical industry.

We have grown a lot of crystals in our hundred years as manufacturers and with them has grown our reputation for consistency and high standards, which proves beyond measure the importance of good husbandry in the production of fine chemicals.



WHIFFENS

Industrial and Pharmaceutical Chemical Division of Fisons Ltd

fine chemicals

WHIFFEN & SONS LTD
NORTH WEST HOUSE, MARYLEBONE ROAD
LONDON, N.W.1
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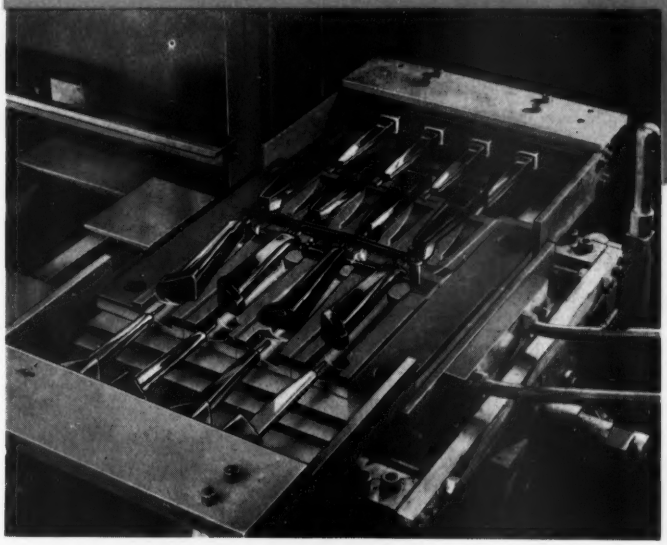
The two handles for the latest pressure cooker consist of an upper and a lower moulding, carefully designed to meet together. Both mouldings are hollowed out, entailing long and slender core pins which dictate the use of a transfer type mould.



THE TOOL AND PRESS

The tool is designed to produce four upper and four lower handles at a time on a BIPEL Type 200 Auto Control Press. The die plate is withdrawn into an auxiliary fixture, where all the side cores are withdrawn at the same time and where, with pneumatic assistance, all the eight mouldings are ejected from their dies.

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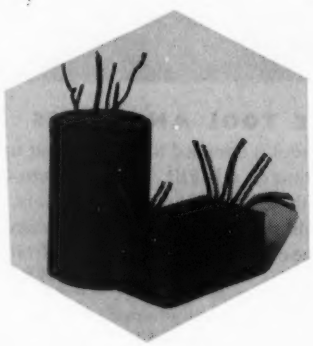

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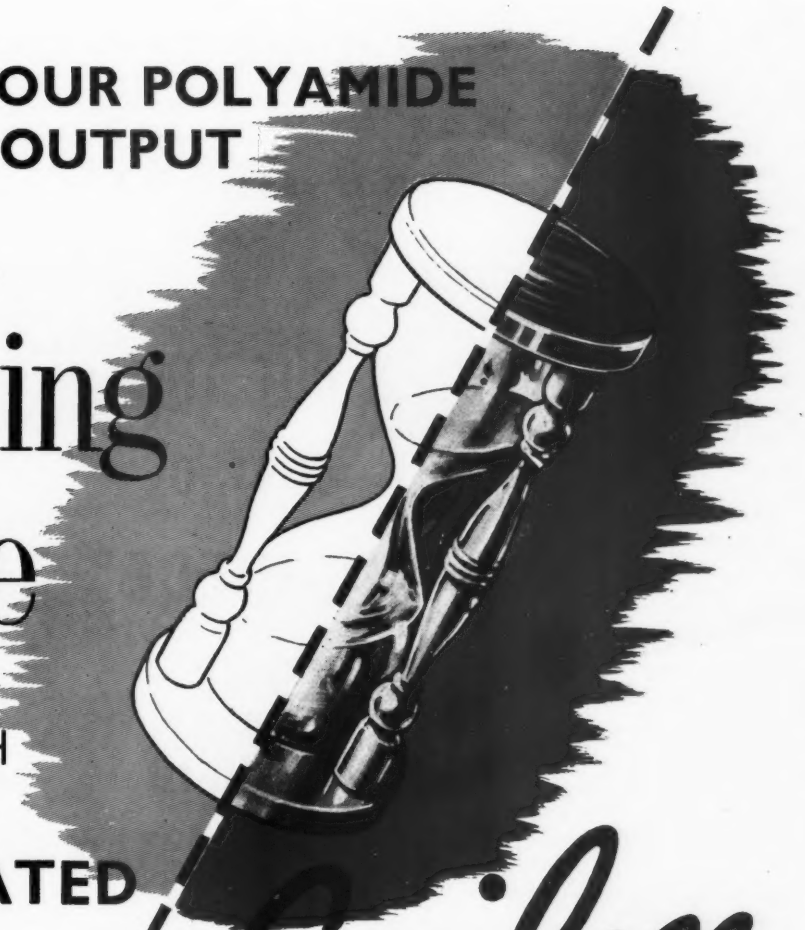

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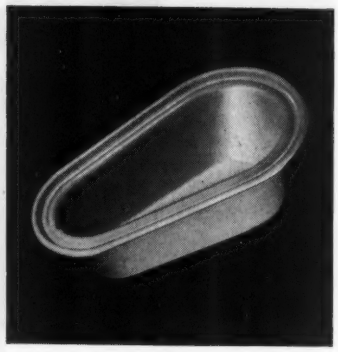

This fine baby bath, in pastel pink, is an example of the first-class results now obtainable with Kleestron Impact Styrene Sheeting, the material that has radically cut the cost of "big-piece" moulding.

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This 22" bathroom shelf injection-moulded in one piece is an example of the type of product which can be made in SUPER 44.

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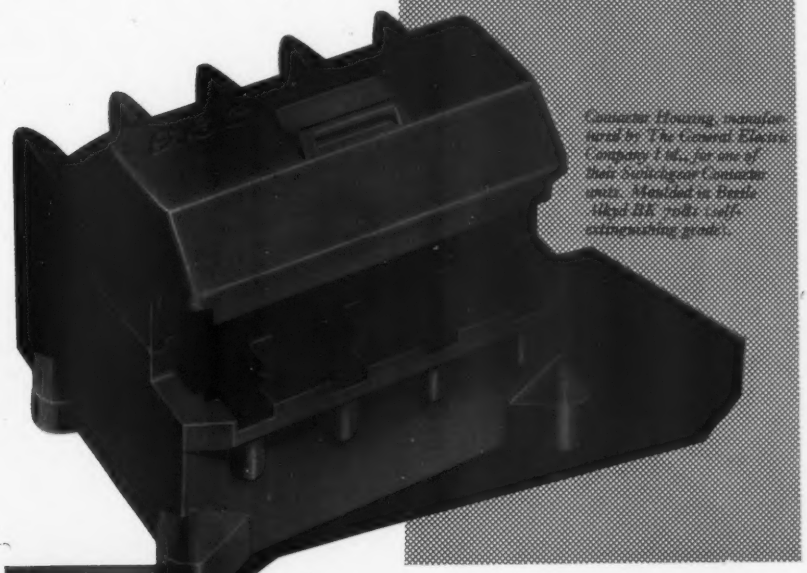

Connector Housing, manufactured by The General Electric Company Ltd., for one of their Switchgear Contactor units. Moulded in Beetle Alkyd BX 708 (self-extinguishing grade).

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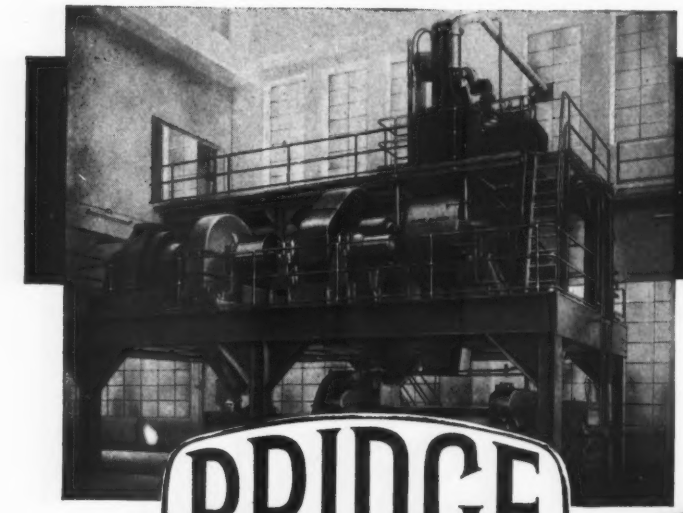

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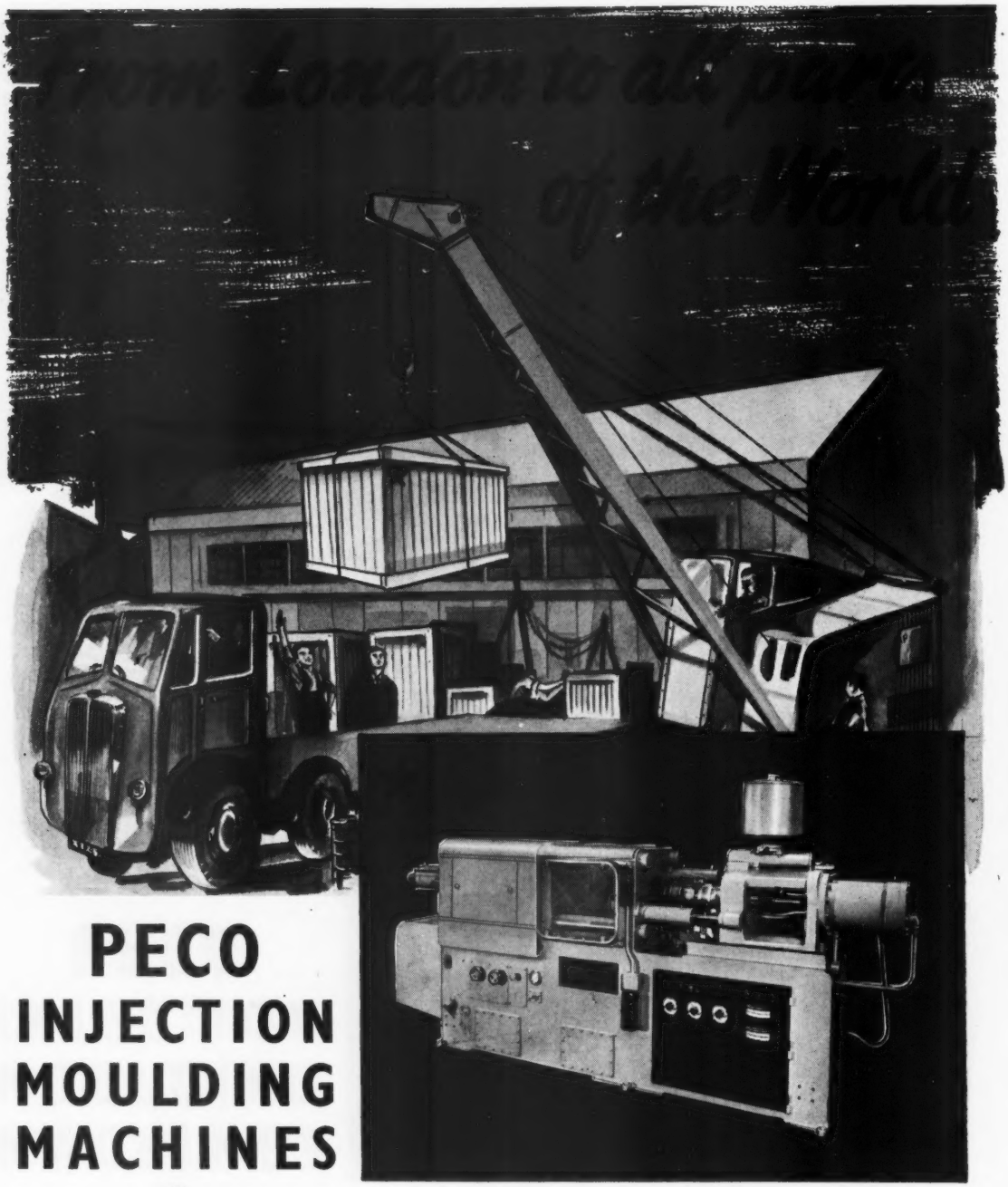

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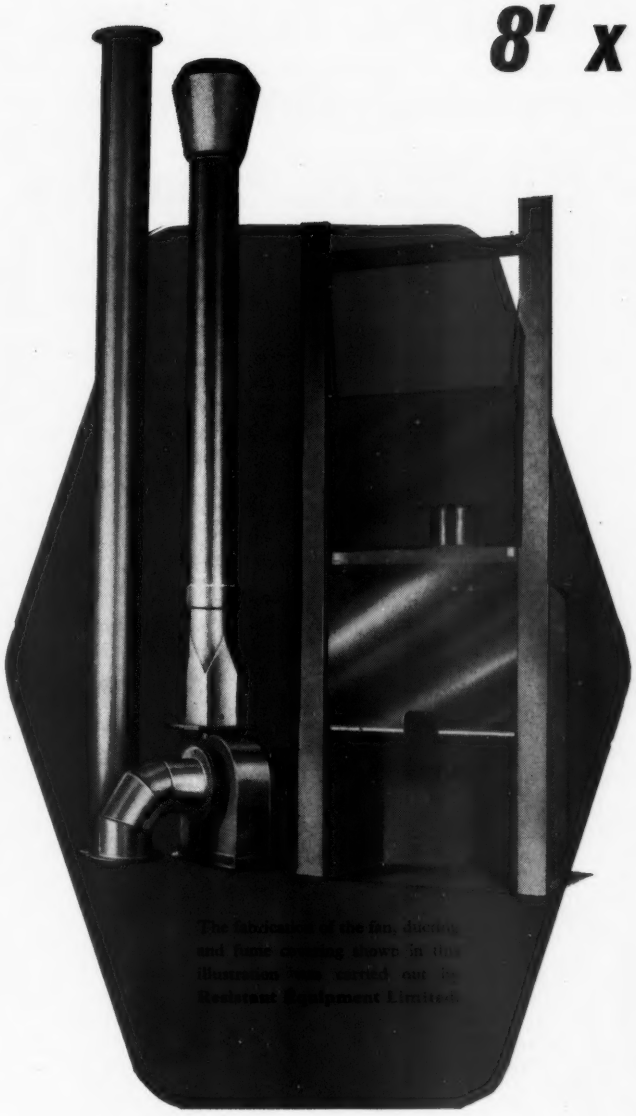

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EDITOR: M. D. CURWEN, B.Sc., A.R.I.C.
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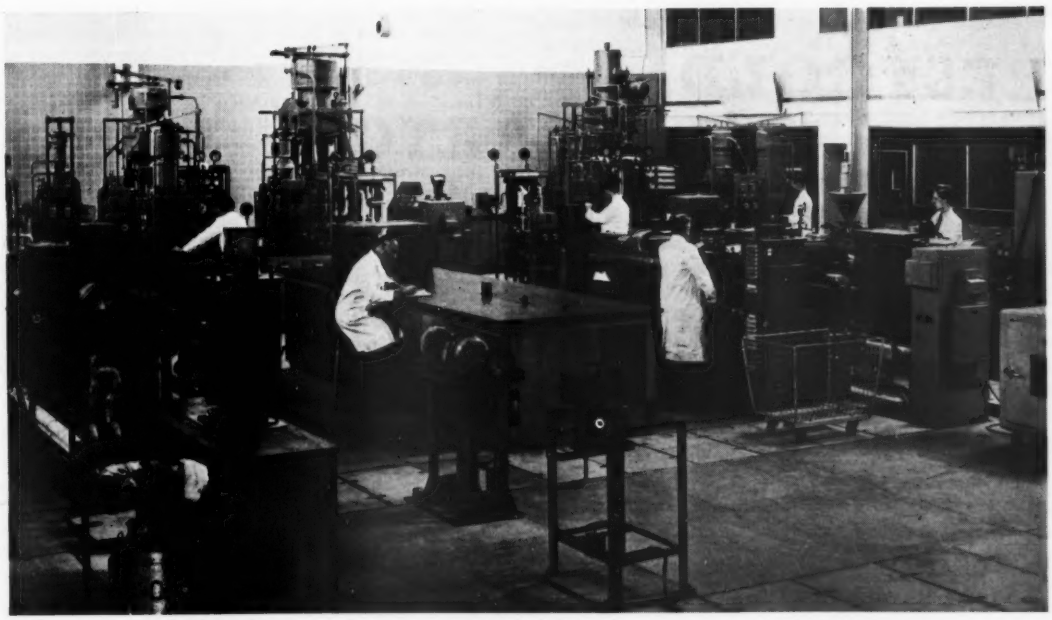
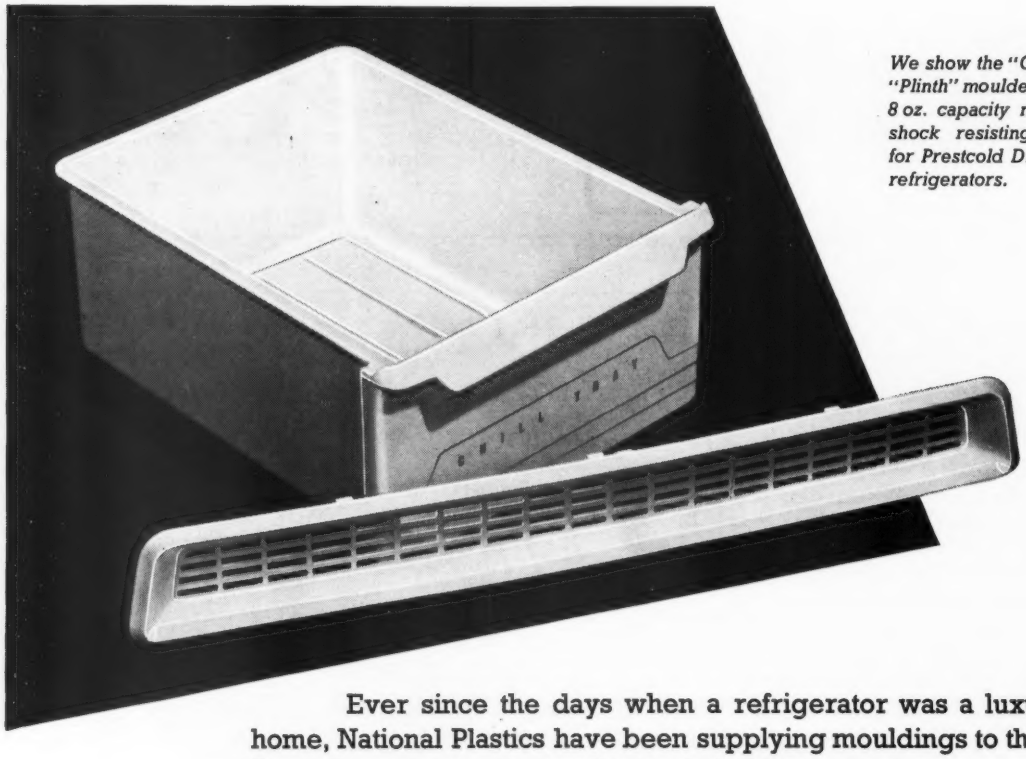


Moulding laboratory in the newly-opened Technical Service Department of I.C.I. at Welwyn.



We show the "Chill Tray" and "Plinth" moulded on 16 oz. and 8 oz. capacity machines from shock resisting polystyrene for Prestcold D.601 and T.801 refrigerators.

Ever since the days when a refrigerator was a luxury in the home, National Plastics have been supplying mouldings to the Pressed Steel Company for their "Prestcold" Refrigerators.
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Plastics

VOL. XXI. No. 229 OCTOBER, 1956

EDITORIALS

Plastic Piping

WE suppose it is no more than 10 or 12 years ago that the idea of making tubes and piping took shape and while there was considerable experiment during this beginning with both p.v.c. and polythene, progress was slow after the war for a considerable period. It was true that we saw an entry into beer conveying and then a spate of garden hose production, but entry into building for cold water supplies was very slow because of the conservative outlook in that industry and this application seems to stultify entry into other and more technical fields. The earliest to show real interest was the chemical field and when this country led the way at last by creating specifications for use in building, the pace of interest increased rapidly.

Today the scene has changed enormously. We have often described in these pages their applications in the chemical industry, not only the tubing and piping for conveying corrosive acids but also the large cylindrical ducting and chimneys that are employed for carrying away acid fumes from chemical and electro-plating plant. There is also the use as acid effluent drain piping, some of the latest examples being 30 in. in diameter. This large type is obviously being made not by extrusion but in relatively short lengths by the hot centrifugal process. There seems even greater possibilities in this field with the production of the more rigid types of polythene.

Use in building increases too, but the largest outlet especially for polythene piping is clearly in the field of agriculture which consumes about 7 per cent. of our total output, and has changed the face of our farming industry by facilitating the carriage of water to hitherto inaccessible points.

Within the last few years, this country has become one of the largest producers of engineering plant for the petroleum industry both for the oil fields and the oil refineries and the supply of piping is exceptionally important. Here the demands are specific and onerous and considerable knowledge of the conditions of working is necessary, for we have present not only oil but also brine from the wells, and the handling of both means exceptional conditions of corrosion, pressure and temperature. Furthermore with geological surveys and the boring of wells being undertaken often in almost inaccessible country the carriage of machinery and other plant by air has become the only economical method, so that lightness of plastic piping gives a tremendous advantage.

In this field therefore there are great possibilities for even more research in plastics and the methods of making such pipes. Polythene especially the newer high density type, the styrene co-polymers and nylon are being employed in ever increasing quantities; nylon piping is now being extruded with outside diameters of 5½ in. The problem of using reinforced plastics still remains to be solved.

A most significant service is being offered by some suppliers in that a close study is made of any industrial requirement and the appropriate material whether it is steel, copper, polythene, nylon, copolymer or other material, is offered with considerable assurance. The pipe-fitting and coupling question, ensuring interchangeability has also been tackled successfully, and nylon piping can be fitted to steel piping.

We have little doubt that the next step will be to attack the even greater market: naval, merchant marine and other oil-firing installations.

Technical Service

WE have recently talked a good deal about technical service in these pages and today we can refer to the opening on October 27 of the new I.C.I., Plastics Division, Technical Service Laboratories. While no doubt fine equivalents are in operation in other countries, we believe that there is no question but that this new creation is the most complete and probably also the largest in the world. It marks a new stage in the development of this company from its beginnings in 1926 and of its ideas of technical service which began we believe with the rubber chemicals section at Blackley, near Manchester, a type of service that is being adopted by so many organizations in other fields.

Of the material construction of this large building 400 ft. long and two stories high, holding 10 laboratories some of which contain enough moulding or other plant to fit out a good small to medium-sized factory, there will be more to say at a future date, for we are writing these notes hurriedly on press day. At least here we can express our admiration for the general brilliance of lay-out, the enthusiastic spirit with which the original ideas have been carried out and the air of certainty of its value to the productivity of the country.

Undoubtedly the laboratories have cost a great deal of money, perhaps of the order of a quarter of a million pounds, but it is too facile to say " great companies only can afford it." Many big companies can afford this sort of spending, or spending on other types of research, but they do not always do it. It is an attitude of mind towards research that matters and this attitude is lacking in far too many organizations to make our country scientifically and technically safe in the new hot industrial war that faces us now. As a very friendly American critic recently stated in an interview on the general problem of technology and productivity in Britain—" Time is no longer on your side."

The Same in Chemical Engineering

IT was also a pleasure to hear of another new example of technical service, in this case in chemical engineering W. J. Fraser & Co., Ltd., one of the great names in this sphere, and a company we have known and admired for 30 years, announce the commissioning of new pilot-scale process laboratories at Harold Hill, Romford, Essex.

The purpose of the new unit is to provide clients with facilities for easy, economical pilot-scale plant testing that can bridge the gap between research results and full-size design. The laboratories will include a chemical analytic laboratory equipped with experimental distillation, with water, gas, electricity, steam, compressed air and high and low vacuum line services and special equipment such as a " Shell " rotating disc contactor for liquid-liquid extraction in the petrochemical field, plant for elucidating separation problems in synthetic resin manufacture, and an open circuit pneumatic drier fitted with a cyclone separator.

It is the first time we believe in our industrial chemical

industry that such an engineering unit has been specifically created for the purpose indicated. It cannot but help speed up technical research in many branches and thus fills a gap that has for so long existed in the chemical engineering field.

Polyester Reinforced Structures

ON a number of occasions during the past few years we have commented on the strange fact that while intense academic research has been carried out on the polyester resins themselves, so little thought has been given to the industrially more important aspect of producing reinforced structures from them. The mechanism of the hardening process, the rôles played by cross-linking agent, catalyst and accelerator or by variants of them and their effect on the " ageing " of the system, have scarcely been studied—a state of affairs almost unique in modern scientific history. As the famous Professor H. E. Armstrong would have said, we are in the Kingdom of Cookery Chemistry.

On another page in this issue, we publish a study of some of the points at issue by two members of the staff in the plastics section of the National College of Rubber Technology, one of whom (Mr. J. Brydson, A.I.R.I.) has had considerable industrial experience in the production of such reinforced structures. The preliminary and tentative conclusions reached should prove at least of general interest—sufficient we hope, to encourage others along similar lines of work.

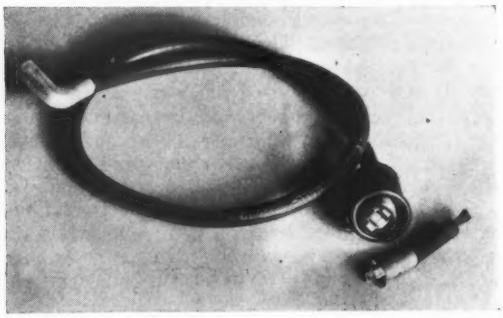
Torquay Conference

THE first British Plastics Federation Conference ever held took place at Torquay on September 27–30. Brilliantly organized and conceived, 150 members, wives and guests thoroughly enjoyed the technical conference itself, visits to Buckfast Abbey and other surrounding beauty spots in Devon, by car and ship, official dinners and dances, golf tournaments and an excellent exhibition of modern plastics moulding and fabrication. Four papers read by Mr. P. A. Delafield, Mr. E. J. Lassen, Mr. T. L. Birrell and Mr. D. Radford will be published in future issues of this journal.

MOULDING POWDER AND SHOT

I have always regarded metal wire, especially copper and aluminium, as the only possible conductors of electricity in the technical sense, although everybody knows of the conducting capacity of graphite with its laminar form and to a less extent other forms of carbon. While not entirely new, a little known application of graphite coupled with natural and synthetic polymers is seen in the high tension lead used on a Vauxhall car and shown below. There is a complete absence of metal wire with the exception of a prong to overcome " termination " problems. The lead itself consists essentially of concentric cotton threads impregnated with colloidal graphite which provides the electrical conducting path. This core is housed in a graphited braid of nylon, the whole being covered with rubber. The lead acts as a pure resistance and thus as an interference suppressor more effective than a condenser type.

What! No Metal Wire?



* * *

As you well know, one of the specialities I can fish up at will from the profound depths of my knowledge, is trade statistics and an encyclopaedic knowledge of world tariffs. H.M. Customs and Tariffs and G.A.T.T. (the Sixth Protocol of Supplementary Concessions to the General Agreement of Tariffs and Trade, Geneva 1956), are my bedside books and what with my vast knowledge of foreign languages, I can translate such little notes as the following in the Commonwealth of Australia Schedule, with the greatest of ease: " Rates of duty appearing in Part II, against which an asterisk in parenthesis—(*)—appears, are scheduled for the purpose of establishing the maximum margin of preference permissible in accordance with sub-paragraph (a) of the last paragraph of Article I of this Agreement, and the inclusion of any such rate in Part II is not be be regarded as binding the preferential rate in respect of any product so scheduled." My real bit of news, and it's an important one, is that Great Britain is working out proposals to bring this country into a West European free trade area, so removing all customs protection, with the exception of a small range of products, between us and the already projected customs union of the Benelux countries, France, Germany and Italy. Furthermore it is hoped that imperial preference will not be affected. Well, it's time something was done, for what a mess there is! I don't mean little things like the import duty on general purpose phenolic moulding powders into G.B. being 20% because it contains wood flour and therefore must be classified under wood and not synthetic resins! But it does show the mind of the bloke who first fixed it at that rate especially since almost all other plastics coming into G.B. have only a 10% duty on them. And this figure is low compared with what a lot of other countries bung on our plastics when we try and sell them abroad. Our duties are the lowest of the big producers; thus Germany's duty is 20%, Italy's 15%, Norway's is 12½% and France's and Austria's are even higher than these. The U.S.A. is very tough too and a good example is the duty on certain synthetic resins which can be as high as 3.8 cents per lb. on top of 28½% *ad valorem.* Bright spots in this world are Benelux, where duty is much lower than the U.K., Switzerland's is only 3% and Sweden's is 10%. Well, after that completely lucid explanation, do you wonder why many manufacturers prefer to grow dahlias instead of duodenal ulcers?

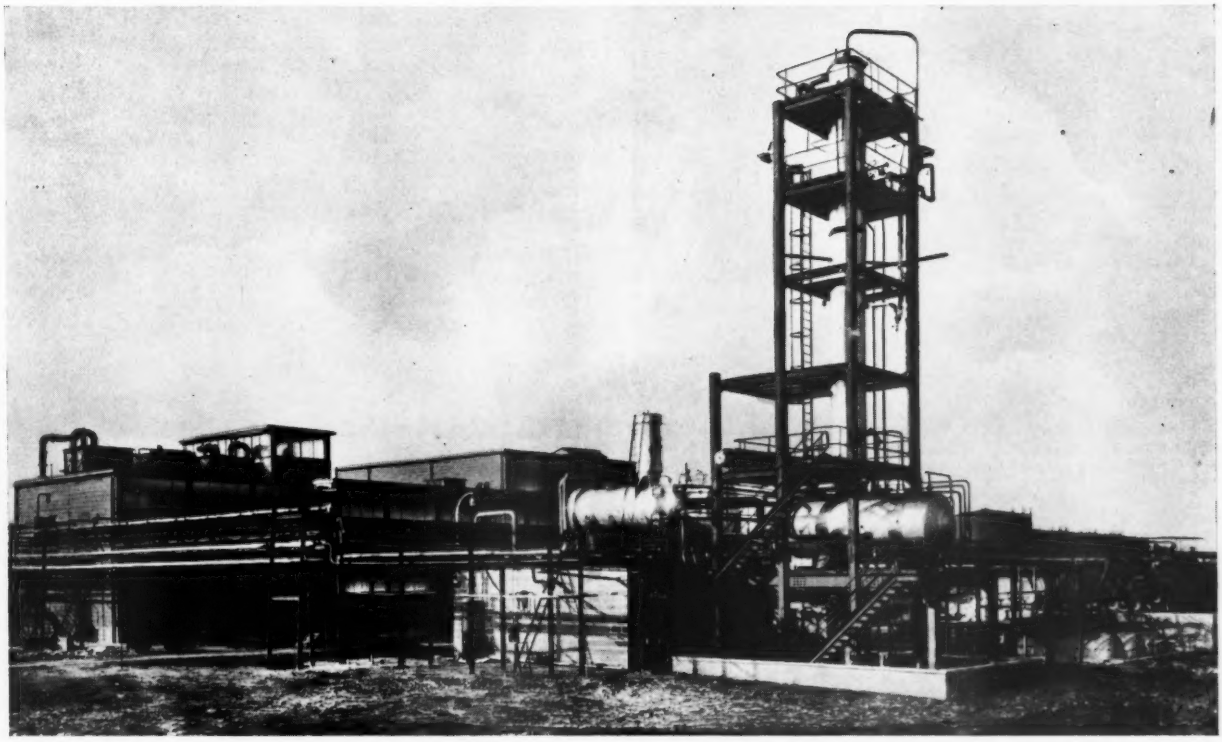
Latest Who-Dun-it?

* * *

A sidelight on the same subject is our relations with our colonies which get very special preference for their exports into this country and of course so they should. Hong Kong is rather a good example of our past work in creating one of the greatest of the world's entrepôts out of a desolate malarial swamp to the benefit of China and the rest of the world. Indeed the latest news from those parts is that the population continues to increase, because of a steady influx of Chinese who prefer this supreme example of Imperialistic oppression and general villainy to the Chinese heavenly Republic. And now Hong Kong is exporting finished plastics goods to this country over 12,000 miles away, at very much lower prices than they can be made here. More power to her elbows, especially since we are assured by the Colonial Office that good wages are paid to the workers. I'm a little uneasy though, because I've seen some examples—of toys—and they're not too hot. The " mechanical " types, such as water pistols, don't always function properly, and it seems as if there's no inspection line in order to save costs. I hope the Colonial Office will send word back.

Death to grasping Empires

DOGSBODDY.



Polystyrene Manufacture

The polystyrene plant of Styrene Products Ltd., at Partington, Manchester, is described, with special reference to processing techniques. New developments are noted, including styrene-acrylonitrile materials and expanded and sheet polystyrene.

THE present annual tonnage of polystyrene made in Britain is about 25,000 tons, produced by Styrene Products Ltd., Distrene Ltd., B.X. Plastics Ltd., Monsanto Plastics Ltd., and Kleestron Ltd. This compares favourably with 10 years ago, when manufacture was much under 1,000 tons per year.

The development of polystyrene for moulding in Britain has been due to the demand for a general purpose material offering the characteristics of cellulose acetate but with improvements from the point of view of rigidity, clarity, dimensional stability, electrical properties, moisture absorption and price. The relatively short development period for polystyrene in this country has been noteworthy both for the rapid expansion of manufacturing capacity, plus the introduction of many specialized grades of powder, in particular those having improved impact resistance.

Today, polystyrene production is a well-established chemical process, and one of considerable interest to the moulder and chemical engineer alike, since it demonstrates the skill and ingenuity that is called for in manufacturing a diverse range of high quality moulding powders. We feel, therefore, that there will be general interest in this report on the Manchester plant of Styrene Products Ltd., engineered by Petrocarbon Ltd., and built by them six years ago on the Partington industrial estate.

Sharing the same site as Petrochemicals and Styrene Copolymers, Styrene Products Ltd. occupy one of the most modern chemical plants in Europe, and at the same time have full access to the substantial technical resources of the Shell Group and of Erinoid Ltd.

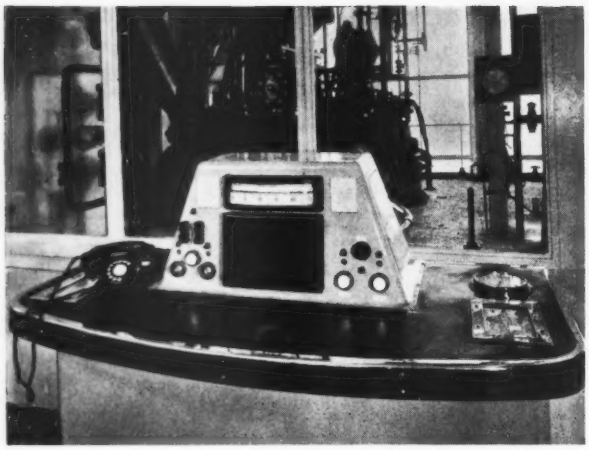
Styrene monomer, from which the polymer is manufactured, is formed by the inter-action of ethylene with benzene, forming ethyl benzene, which is subsequently dehydrogenated to give a mixture of styrene monomer and ethyl benzene, the latter being recycled through the dehydrogenation plant. Both ethylene and benzene are directly accessible from petroleum cracking of the type carried out, for example, by Forth Chemicals in Scotland, or Petrochemicals Ltd., at Partington, or from coal.

The liquid monomer is inhibited, to prevent polymerization during transit and storage, by the addition of para-tertiary butyl catechol. At all stages, as will be seen later, extreme emphasis is placed upon purity of all materials employed, since only in this way is it possible to guarantee consistent products.

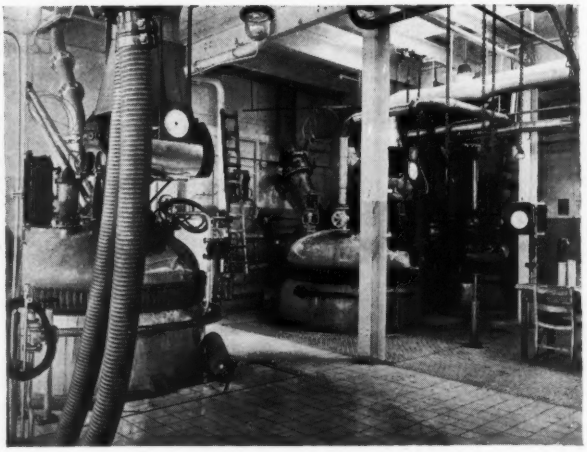
The liquid monomer is drawn from the storage tanks to the distillation plant, where volatilization of the liquid frees it from the inhibitor, and also removes impurities and low molecular weight polymer that may be present. It is then pumped to the top of the polymerizing plant where it is metered down to the reaction kettles of 1,000 gallon capacity. They are of glass-lined construction, fitted with paddle stirrers, and are fully equipped with control apparatus for the maintenance of critical operating conditions.

Polymerization

Into the vessel are charged the monomer, or monomers for a copolymer, water, catalyst, stabilizer and where applicable lubricant. In this type of polymerization reaction, known as the " bead " process, the function of the water is to hold small particles of the monomer in suspension. The stabilizer helps to maintain the suspension and to keep the particles, or beads, at a constant size. It also prevents coalescence when the material is at a " sticky " stage intermediate between the liquid monomer

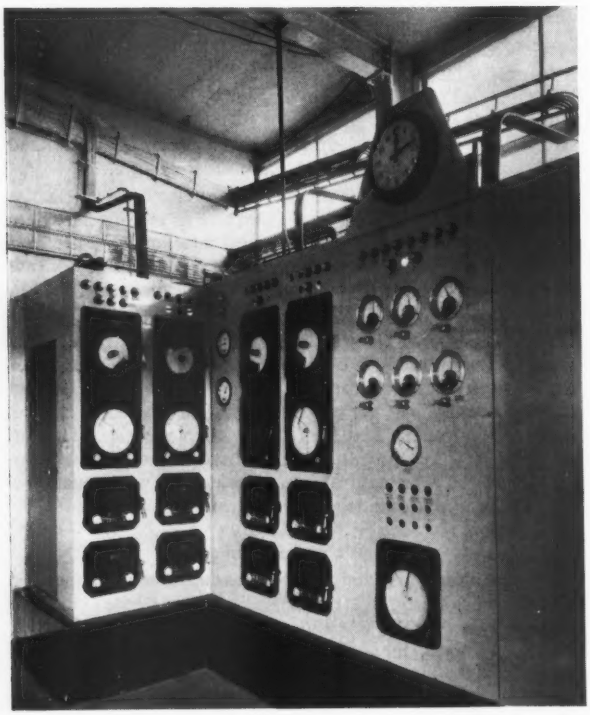


Conditioning control desk, showing high degree of automation incorporated in this plant.



View of reactor room. Kettles are of 1,000-gallon capacity, and are glass-lined.

and the hard polymer. The rotating paddle ensures that all of the mass is kept in movement and equally heated by the walls of the kettle. The reaction temperature is very carefully controlled, since this has a direct influence on the type of polymer produced. Rapid heating and a short reaction will yield a material of low viscosity and low molecular weight, unsuitable for moulding, whereas a lower operating temperature and a long reaction will give a material of high viscosity and high molecular weight. The reaction temperature is brought to a final temperature well above that of boiling water: cooling on completion of reaction permits lowering of pressure and discharge of the solid beads which are in the form of a slurry in water. Instrumentation plays a large part in the successful operation of a large polymerizing plant, and Bristol-type recorders are employed to record the temperature paths of each reaction.



Part of the main control panel, adjacent to the reactor room.

Here it may be worth pointing out that the bead polymerization process has been selected out of a number of methods, primarily because it is flexible and permits of very accurate control, particularly of the molecular weight. Alternative methods, such as mass polymerization, sometimes permit " hot-spots," that is localized areas of intense reaction and heat resulting in a disparity of the molecular weight. In the bead process, each small globule is polymerized as a separate entity, separated from its neighbours by the water phase.

From the reactor's base the polymer and water are dropped through a sieve which removes oversized particles. The mass is then pumped into wash kettles, similar in pattern to the reactor, but run cold. Here the mass is agitated with specially purified water (the whole plant operates on a water purification system), and is then passed to centrifuges where most of the water is removed. The residual water is driven off by passing the beads through drying equipment, of two kinds. The first consist of vibrating conveyors, fitted with baffles, the movement of the beads being against a hot-air flow. An alternative process is the rotary oven, constantly turning-over the particles as they move through its length.

The resultant dried polystyrene is then charged into storage hoppers lined with glazed tiles. It is from this reservoir of varying grades that the customers' requirements are met.

Mixing

The final transformation of the material into the form in which it appears in the moulding shops is effected first by mixing. The mixers disperse the colouring agents into the polymer, mixing being carried out in stainless steel tubs. Extensive use of stainless steel is noteworthy throughout the entire plant, making for ultra clean conditions.

At this point each mix is card indexed, tailored, as it were, to the customer's specifications. The mix is taken to the extruders where it follows the normal process of extrusion cooling, and cutting into granules. Extruders of special design are employed, having a smaller barrel length/screw diameter ratio than is common practice. They have been specially developed by Erinoid Ltd. and have been found to give superior mixing characteristics.

The final stage is completed by packaging in multi-wall sacks, and despatch. It is no exaggeration to say that an order for a special grade and colour telephoned to the plant on one day is frequently made and delivered to the customer on the day following, using Styrene Products own transport fleet.

This opens the question of flexibility, the keynote of success in a highly competitive market. It is on this point that the

judicious balance is maintained between large tonnage throughputs and the requirements of the large and smaller moulder. There is no doubt that the ability of a plant to handle quickly demands for large and small quantities of diverse grades and colours of moulding powders is the all-important factor to the salesman who is in daily contact with his clients, the moulders. Styrene Products place great emphasis upon this point.

The diversity of products is evidenced by the fact that eight main groups of moulding powder are offered for sale, as follows:

(1) General purpose material.

(2) Improved strength clear material, suitable when mouldings require to be drilled, flexed, etc.

(3) Heat resistant powder, containing no lubricant, and virtually monomer free. This grade is widely used for film production.

(4) High molecular weight/high softening point grade, the preferred material for mono-filament production.

(5) General purpose high impact grade, a styrene/butadiene material.

(6) A combination of 3 and 5 above.

(7) An easy flow grade, specially devised for difficult mouldings.

(8) A fast cycling grade, having quick setting characteristics.

Testing and Research

As mentioned earlier, the Manchester plant operates in close liaison with the technical department of the Shell Group and Erinoid Ltd. Work at Styrene Products Ltd. is therefore largely directed to plant research, and product testing. In the latter category a quantity of interesting work is carried out.

Monomer is tested before and after distillation, to check that it is inhibitor free, and also free from impurities such as phenyl acetylene.

The polymer undergoes rigorous examination through all stages of manufacture including particle size checks; softening point, indicating freedom from monomer; ultra violet absorption test, for the same purpose; ash content; and viscosity, indicating molecular weight. Two 1-oz. injection moulding machines are located in the production laboratory, and are run on standard cycles and moulds, enabling colour checks to be made on the virgin polymer.

The powder itself undergoes a further series of tests before it is despatched. Here an 8-oz. Peco injection machine is employed to mould standard test pieces; and tensile and impact strengths are evaluated. Colour is checked against master samples, of which there are now well over 800. Only by continuous checking is it possible to maintain a consistently high standard of product.

New Developments

In the course of active development at the moment are two products of considerable interest, styrene acrylonitrile, and expanded polystyrene.

Moulding powder is delivered into hoppers, and bagged ready for despatch to customers.

Co-polymers of styrene and acrylonitrile are not of course new, although they have never been commercially manufactured in Britain before. A patent was awarded to I.G. Farbenindustrie as early as 1937. The main feature of these materials is their superior impact strength, and resistance to staining and attack by petrol and fruit juices. Applications range from reflectors for cars to picnic and tableware.

Expanded polystyrene offers great promise as an insulant against cold, as a cork substitute and also for buoyancy, display and toys, etc. The blowing agent is incorporated during the polymerization reaction, and the bead from the reactor forms the raw material. In closed moulds, and at relatively low temperatures, the beads expand to at least 40 times their original size. Very close control of the interstices dimensions can be maintained.

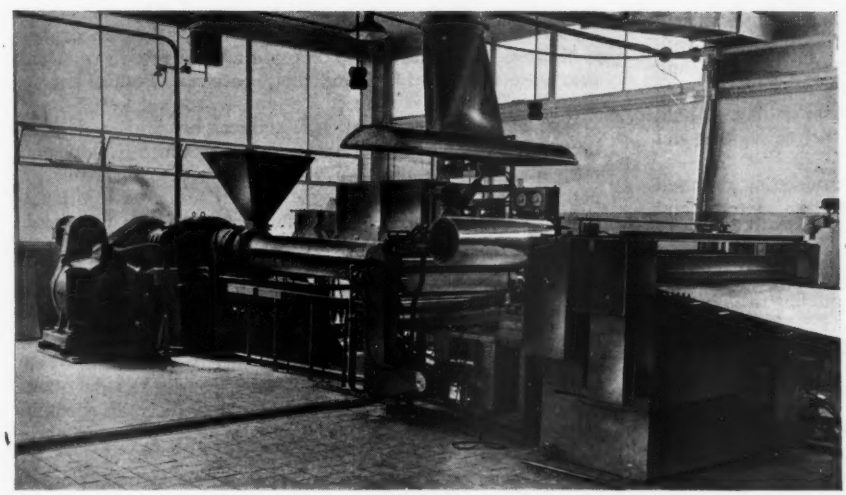
Sheet Extrusion

Primarily as part of the technical service facilities offered to customers, a polystyrene sheet extrusion unit has been installed, based on the Hartig extruder. This enables materials to be evaluated and their behaviour under vacuum forming processes to be studied. When required the company produces sheet material to the customers' requirements.

Conclusion

Although essentially a mass production process, polystyrene manufacture is shown here to exhibit a high degree of elasticity. This has contributed, to a very large extent, to the successful commercial exploitation of polystyrene, which now ranks as the most important thermoplastic moulding material.

We acknowledge the assistance given by Styrene Products Ltd., in the preparation of this report.



The sheet extrusion plant, served by a Hartig extruder.

Performance Factors in Injection Moulded Polythene Domestic Ware

By A. B. GLANVILL, A.M.I.Mech.E.

Since little experience has yet been gained with high density polythene in terms of lengthy evaluation, this review is concerned only with low density material

THE large scale adoption of polythene domestic ware by housewives throughout the world in a comparatively short period of time and its continued steady rise is ample demonstration of the suitability of the material for this purpose, and its ability to confer advantages, in many cases, over certain of the more traditional materials.

Parallel with this rapid rise in production has been the steady accumulation of service experience and due attention to this knowledge must be paid by designers, engineers and manufacturers if the favourable acceptance of polythene household utensils by the public is to continue and increase on a healthy basis. No material can be ideal in every respect for every purpose and it is the manufacturer's responsibility to so design and manufacture his product that the effect of the limitations of the material are reduced to the minimum. It must be remembered that the limitations of the traditional materials for domestic ware—galvanized and enamelled iron, glass, and china—are well known and accepted by the housewife. Such is not, and will not be, for some years the case with polythene. If the housewife drops a saucepan into an enamelled iron bowl and chips it, she does not blame the bowl manufacturer for a poor product but herself for dropping the saucepan. If, however, she places a hot saucepan in an empty polythene bowl and marks the plastic, it is noted as one of the poor features of polythene bowls rather than her own carelessness. Of course with many of these features little can be done but to continue to educate the public until proper usage of the material becomes second nature. However it is apparent that some of the difficulties encountered can be avoided or mitigated by a broad appreciation of the extreme of service conditions and consideration of the influence on performance of the natural characteristics of the material.

Service Conditions

Polythene domestic ware has to withstand many onerous conditions in usage—much of it amounting to sheer abuse. None-the-less until the material has built up its own tradition it will continue to suffer. Some of these conditions are:—

(*a*) It will be cleaned by methods known to the housewife from experience with other materials; e.g. abrasive cleaners and scouring cloths.

(*b*) Containers will be filled with boiling fluids.

(*c*) Mouldings will be brought into contact with hot surfaces.

(*d*) Containers such as bowls and buckets will be filled with all kinds of contents both liquid and solid, hot and cold; and in addition to the housewife's requirements will also be used on occasion by the husband for his own purposes (e.g. to hold coal or ashes, cement, paint and distemper, petrol, paraffin and oil, etc.).

(*e*) The mouldings will be dropped, and trodden on and used to stand on to reach a high shelf. They will be squeezed and distorted into too small a place in cupboards and recesses.

(*f*) Racks and trays will be overloaded and distorted.

Of course in many instances the very nature and properties of the material make it impossible for the moulding to withstand some of these eventualities. Nevertheless with the choice of sound applications for polythene domestic products, careful design and correct moulding, much can be done to avoid some of the failures that do occur.

Performance Factors arising from Service Conditions

Cleaning.—Probably one of the two greatest difficulties arising from polythene domestic ware is the problem of cleaning (the second being burning). The housewife has learnt by experience with the traditional materials that recalcitrant dirt is dealt with by the use of abrasive cleaning powders and scouring cloths, and sooner or later the polythene is subjected to the same process. It is largely as a result of this treatment causing the original glazed surface to be broken down and roughened that many of the other difficulties arise.

Firstly, as soon as the original gloss has gone from the material the appearance is spoilt and the colour is obscured by scratches and a matt coat of abraded polythene. Then, even when new, it is somewhat difficult to tell when the moulding is really clean and once the surface is broken this problem is increased. Again in the case of bowls, sink strainers, buckets and kitchen bins, polythene appears to have a tendency to sliminess from wet refuse and this likewise is increased as soon as the original surface has been broken.

It therefore has to be recognised that polythene does not take as kindly to one of the most basic and deep-rooted household cleaning methods as most of the other conventional materials used for domestic ware. Even with mouldings that may escape this type of cleaning and are only washed in the normal manner eventual loss of surface appears to be inevitable. In general, most mouldings lose their gloss in the course of time either from the effects of liquids or cleaning or from abrasive wear in service.

No outright solution to this problem is of course possible since it is an inherent feature of the material that the surface readily becomes roughened:—some steps can however be taken:—

(*a*) To continue the education of the consumer public in literature and labelling, with respect to the most suitable cleaning methods.

(*b*) To ensure that designs follow normal hygienic lines to prevent the accumulation of dirt and allow proper access for cleaning.

(*c*) To bear in mind the effects of colours both for ready visual confirmation of cleanliness and for its appearance when roughened under abrasion.

(*d*) To protect outside surfaces as far as possible from abrasion of contact (e.g. feet on bowls, etc.).

Before leaving this subject one final common cause of surface wear might be mentioned—the practice of using polythene containers for the mixing, handling and storing of dry foodstuffs —of which two of the most common are the mixing of sugar bearing mixtures and the handling of potatoes. Both of course cause similar abrasive wear.

Staining.—Another result of surface breakdown is the immediate liability to staining. Liquids which would not normally have any effect on glazed polythene are capable of permanently staining the roughened surface after continual usage. These include tea stains and fruit juices in polythene beakers. In washing up bowls it is not uncommon to find the bottom portion stained after long use although it has been found that the most severe staining takes place from home dyeing liquids. Some chemical sanitary cleaners have also been found to cause partial staining after prolonged contact. (Fig. 1.)

Failure and Permanent Distortion from Heat and Load.—The low softening point of polythene (when compared with other traditional domestic materials) and its reduced tensile strength at temperatures close to this point also give rise to another series of service failures.

Containers, especially, are sometimes liable to be subjected

Fig. 1. Example of staining caused by home dyeing liquids. The staining commences halfway down the side of the bowl and is especially marked across the base.

to extreme conditions of heat and load causing either rupture or permanent distortion. Examples are the emptying straight from the boiler of water and a heavy mass of clothes into bowls and buckets—which may be subsequently heavily squeezed or pressed. Polythene colanders too are frequently suspended over a saucepan of boiling water and the greens heavily pressed out.

Burning.—Failures in this respect are caused by:—

(*a*) Placing mouldings accidently on recently extinguished gas stoves, or on electric hot plates or boiler tops.

(*b*) Using mouldings over saucepans, etc. (particularly on gas stoves) and in which the moulding projects over the edge of the saucepan and the heat extends beyond the base. The heat in consequence impinges directly on the polythene causing rapid failure. (See Fig. 2.)

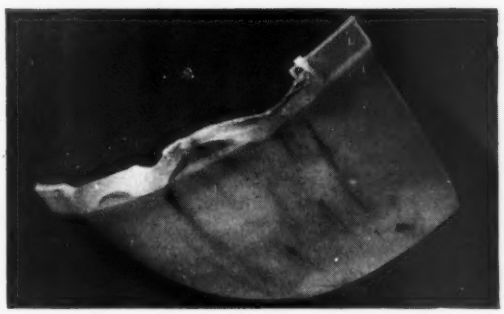


Fig. 2. Result of standing moulding on hot stove.

(*c*) Attempting to heat liquids by placing polythene containers directly on a stove or boiler.

(*d*) Allowing hot metal objects to come into contact with the plastic moulding. A common example is the placing of hot pans off the stove into empty bowls lying in the sink.

(*e*) Hanging or standing polythene domestic ware above stoves where the uprising heat causes melting or permanent distortion. In particular this can readily occur if mouldings are placed on the overhanging top grid of gas stoves and is accentuated if a saucepan or kettle is removed from the stove and the gas burner left on.

Fig. 3. Base of feeding bowl showing cutting marks from knife.

Cutting.—The softness of the material is often not appreciated and attempts are made to cut up foodstuffs in washing up and feeding bowls, colanders, etc. As a result the mouldings are often cut about on the surface or even perforated (especially with sharp pointed kitchen knives). (See Fig. 3.)

Splitting of Sprue.—In most polythene domestic mouldings produced under conditions of high output the sprue area is under internal stress. If this stress is too high and/or the sprue is broken off below the surface, the moulding is likely to split and perforate at this point. This condition is accelerated if the article is subjected to heat and load in service.

Environmental Cracking.—Certain grades of polythene which are particularly suitable for the production of domestic ware (due to high gloss and ease of moulding) are also unfortunately especially liable to failure from this cause. Contents (e.g. strong detergents, certain culinary oils, etc.) which would not normally have any effect on polythene will cause splitting of injection moulded containers, particularly under conditions of heat and load. Fortunately this is not generally a serious problem since domestic usage does not normally involve conditions likely to lead to environmental failure. Some domestic mouldings, however (e.g. bowls and buckets), have been used for other purposes (industrial and medical). Under such conditions failures have occurred from contact with chemicals that are cracking agents. Liability to failure is also increased by incorrect moulding conditions.

Delamination.—After a period of service—often 3–12 months—some domestic mouldings have been found to delaminate extensively on the surface. This appears to be a condition of inaccurate moulding technique although, since most of these failures appear to occur in bowls, other contributory factors seem likely. Prolonged contact with a few items such as animal fats has been known in isolated instances to lead to absorption and consequent delamination. (See Fig. 4.)

Fig. 4. Surface delamination on the base of kitchen bowl.

Splitting of Knit Lines.—As with other plastic materials, knit lines are a source of weakness. In some mouldings these sections are subjected to stress in use and if the material has not properly welded the moulding will split under load. Domestic mouldings employing integrally moulded handles are an example of products liable to this type of failure.

Performance Factors arising from Natural Characteristics of Material

Flexibility.—Due to the pliable nature of the material, particularly in thin sections, close consideration must be given in the design to imparting maximum structural stability (unless

of course flexibility is a feature). This stability is of importance in such things as bowls where flexibility allows spillage when carried, in such items as bath trays, plate racks, etc., which may be loaded unequally, and in products incorporating handles. With handling, too, it should be remembered that utensil mouldings may be picked up at any convenient point and with one hand or two. In the case of containers, provision has to be made for the increased flexibility when filled with hot liquids. Particular care is required in the design of mouldings in which one or more of the sides is structurally flexible in one plane and which springs from a relatively inflexible corner. Such may be the case with a flat sided container which could be more flexible than a curved sided container of equal section due to the structural arch in the lateral plane. In cases of this sort deflection tends to occur over one area with exaggerated effect.

Lightness and Buoyancy.—Some domestic articles require reasonable stability of position and freedom from liability to tip over (kitchen waste bins, toilet brush holders, etc.). Since the material is so light this must be achieved by a broad base and low centre of gravity and, if necessary, by additional weighting. With mouldings used in sinks (e.g. bowls and sink strainers), their practice of floating when water is emptied out tends to be annoying: little, however, can be done in this respect (enamelled iron bowls, of course, also float, but not so readily.)

Colour.—The colours of polythene household mouldings as currently produced are limited to an extent in brilliance and depth of colour when compared with ceramics or high gloss enamels. This limitation is not serious, but the appearance tends to fall off rather rapidly as soon as the moulding goes into continuous service, if it is subject to any type of cleaning or wear.

Fig. 5. Severe silicone cracking.

Section Thickness.—From the point of view of service performance the section thickness used does not appear to be critical within reason (subject of course to the load conditions not exceeding the safe stress of the material at the maximum service temperature). Depending on the particular design, however, it may be of importance for reducing flexibility (especially under conditions of heat) and for increasing weight to maintain stability of position. In this respect too it might be noted that based on experience with traditional materials, consumers tend to judge a heavier product as of superior quality to a light one.

Performance Factors arising from Production Conditions

A number of polythene mouldings fail after a period in service as a result of material or manufacturing conditions. Some of these have already been mentioned but the following can also cause defects.

Contaminated Material.—Mouldings produced from an injection cylinder that has not been properly cleaned or purged from another material may be contaminated and fail in service through splitting or delamination. Contamination from oil or included air can also cause surface defects.

Silicone Cracking.—Mouldings in grades of material generally employed for domestic ware are very liable to splitting along the flow lines if produced from moulds treated with silicon release agents. The effect does not become evident until some period after moulding. (See Fig. 5.)

Ruptured Ejection.—This fault is rare but under extreme conditions of difficult ejection combined with too short a setting time, internal delamination of the material can occur. This defect is not easily seen at the time of moulding but after cooling to room temperature and flexing, the rupture shows up. In service this fault does not appear to cause failure but can detract somewhat from the appearance. (See Fig. 6.)

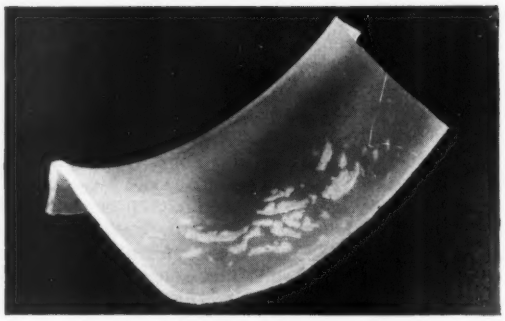


Fig. 6. Internal ejection rupture.

Packing.—The nesting of mouldings for packaging purposes is commonly practised. It should be borne in mind, however, that if carried to excess this may cause the mouldings to be kept under undue stress. If the articles already have an internal weakness through design or moulding conditions this extra stress may be sufficient to cause actual failure. An even more common result is to cause semi-permanent distortion of the mouldings (especially with mouldings nested too heavily straight off the press). When cartoned, the resulting handling drives the mouldings continually more tightly into each other and setting an unreasonable strain upon them.

Warping.—Under some conditions of moulding the internal stresses set up may cause the product to take up a permanent warp. This is particularly the case in mouldings in which the rigidity of the material forming the constraint of movement in one plane is overcome by the unbalanced internal stress (notably in large mouldings with flat surfaces such as draining boards, container covers, etc.). If tendency to warpage is likely the design must either provide for maximum rigidity in the essential form, or flexibility allowed in the functional application.

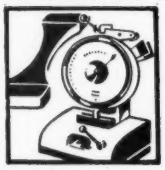
Low Surface Gloss.—The attainment of maximum surface gloss is of importance both for visual attraction and ease of cleaning. This glaze may be below optimum if moulding conditions are not ideal, tool finish is inferior or low gloss grades of material are employed.

Conclusion

All these aspects of polythene for use in household products, the conditions met in service, the natural properties of the material in relation to its functional usage and the influence of manufacturing conditions on performance—have been encountered at one time or another by most technologists interested in this field. It is true too that some of the conditions mentioned are extremes rather than average experience. None the less it is hoped that this summary may assist in ensuring that past experience is used to enable the extending range of polythene domestic ware to continue and improve the favourable reception of consumers by a full appreciation of the performance factors involved.

World's Industry Employs Plastics

MATERIALS and TESTING



Charpy - impact strength of styrene.—H. Hoegberg investigated the impact strength of four different types of styrene after the Charpy method varying the shape of the mould and the moulding conditions. The aim should be to have production conditions which give isotropic injection parts of uniform quality. There is a discussion of impact methods. One sided clamping does not fully reveal the physical properties. The "impact toughness" expressed in kg/cm and the mechanical anisotropy may be best investigated by the investigation of two different samples, one injection moulded in a lateral, the other in longitudinal, direction.
(*Kunststoffe*, 1956/Aug./350.)

Urea and melamine contents of condensation products.—R. G. Widmer describes a method for the quantitative determination of urea and melamine in cured and uncured technical products which contain urea- and melamine-formaldehyde condensation products. This method can be used favourably by non-specialized laboratories with less skilled assistants and is accurate for technical purposes.
(*Kunststoffe*, 1956/Aug./359.)

Double refraction of injection moulded styrene components.—S. Wintergerst and K. Heckel show that the opinion is not correct, that double refraction phenomena in injection moulded styrene products are due to frozen-in stresses.
(*Kunststoffe*, 1956/Aug./365.)

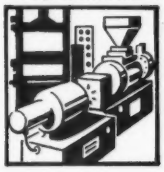
New methods for an investigation of plastics.—W. Bruegel describes two new basic methods for the investigation of plastics: magnetic nuclear resonance spectrometer after Bloch and paramagnetic electronic resonance. Both methods and their application are described in detail.
(*Kunststoffe*, 1956/Aug./366.)

Testing of artificial leather, endurance bending test.—A draft standard DIN 53 359 has been prepared describing in detail the preparation of the samples 20 × 40 mm. with a free clamping length of 20 mm. which is reduced to 2S + 2 mm. for samples of single thickness S and to 4S + 2 mm. for folded samples of 2S thickness.
(*Kunststoffe*, 1956/Aug./373.)

Removal of contaminating dust.—Pressurization is necessary in modern plastics plants to remove contaminating dust. Dust causes serious distortions in contact-formed parts in moulds. Metal dust seriously reduces radar transmission of radomes. Tiny specks of oil reduce the bond strength of plastic parts.
(*Automotive Industries*, 1956/Aug.1/67.)

High temperature use of p.v.c. insulation.—About six years ago Geon 863 became the first vinyl compound approved for use at 105° C. This led to constructions taking advantage of the improved high temperature ageing properties. The following constructions became possible: (1) 105° C. appliance wire with wall thickness of $\frac{1}{64}$ to $\frac{1}{32}$ in. rated at 300 and 600 volts. (2) 90° C. appliance wire rated at 1,000 volts. (3) 90° C. appliance wire with 0.008 in. wall thickness. (4) 80° C. oil resistant wire.
(*Wire & Wire Products*, 1956/July/768.)

PROCESSES : MACHINERY



Injection moulding machine.—A redesigned machine by Lewis Welding & Engineering Corp. makes 360 dry cycles per hour, moulds up to 20 cu. in. per shot, plasticizes 100 lb. of material, has a shot capacity of 12 oz. of polystyrene with pre-packing and accommodates moulds 14.5 × 24 in. in size. Injection pressures up to 21,000 lb./sq. in are reached.
(*Automotive Industries*, 1956/Aug. 1/86.)

Time fixing in a moulding plant.—R. Kainz gives useful hints for time planning in moulding plants to ensure a friction free collaboration between sales and production department. A graphical analysis of the production process is given.
(*Kunststoffe*, 1956/Aug./385.)

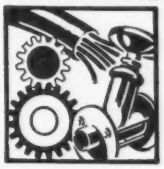
Injection mould with heating channels.—In his survey on the design of tools for injection moulding machines H. Gastrow describes a triple mould for making beakers. Technical details are given.
(*Kunststoffe*, 1956/Aug./386.)

Separating machine for vacuum formed components.—The increasing use of vacuum formed parts has raised the problem of separating the deep drawn parts quickly and economically. Recently special cutting machines have been developed, the basic operation of which is described.
(*Kunststoffe*, 1956/Aug./389.)

Injection moulding bottles.—A description of an automatic process for the injection moulding of plastic bottles is given. The first stage is the moulding of tube with a sealed end around a hollow core. The mould itself is a split mould keyed into a block and held against the action of a compressed spring by the locking pressure of the press. When the press is opened the spring opens the splits leaving the moulded sleeve on the core. The two halves of the bottle mould then move round the core and when locked in position actuate a rod linkage opening the compressed valve at the end of the core and blowing out the tube to the bottle shape. The bottle mould is then opened and the bottle discharged. Drawings of the moulds and a full description is given by the author, Heinrich Spies.
(*Der Plastverarbeiter*, 1956/July/250.)

Polyamide-epoxy blends for tooling.—The new blends for tooling have two notable advantages. Higher impact resistance is the first one and the elimination of the need for a toxic curing agent is the second. The polyamide resins used known as Versamids, are based on vegetable dimers. Besides the non-toxicity of the resin less exothermic heat is generated during the cure thus enabling thicker sections to be cast.
(*Materials and Methods*. 1956/July/106.)

INDUSTRIAL APPLICATIONS



Polyvinyl chloride in finishing shops. — H. Starbuck indicates the many practical possibilities for rigid polyvinyl chloride in galvanizing shops for exhaust ducts, hoods, spray pickling tunnels and as covering material for steel sheets, spray chambers, fume scrubbers.
(*Product Finishing*, 1956/Aug./78.)

MISCELLANEOUS USES

Institute for plastics treatment.—A short report of the 1955 activities of the Institut fuer Kunststoffverarbeitung in Industrie und Handwerk connected with Techn. Hochschule Aachen has been given. Besides lectures, research investigations have been carried out and practical work courses held.
(*Kunststoffe*, 1956/Aug./391.)

Fixing p.v.c. railings.—German firms have developed electrically heated hand tools for fixing P.V.C. railings to staircases, railings, etc. The equipment is adaptable and is also obtainable in special designs.
(*Kunststoffe*, 1956/Aug./388.)

Convention "Plastics and Caoutchouc," Bad Nauheim.—At this convention at the end of April, 1956, the 75th birthday of Prof. H. Staudinger was celebrated. Papers were presented by Prof. C. Natta on stereospecific catalysis and isotactic polymers. Prof. G. V. Schulz spoke on reaction-kinetics of the molecule combination of vinyl polymers; G. Bier on the structure of polyvinyl chloride; F. Helfferich on ion exchangers; W. Scheele on vulcanization of natural caoutchouc through connections of the thiuran series; H. Westlinning on the structure of fillers and their action in caoutchouc and plastics; R. Ecker on secondary softening ranges of mixed polymerizates, etc.; H. Thurn on mechanical and dielectric damping of vibrations in high polymers; K. Wolf on irradation of plastics with high-energy particles; H. Kiessig on the importance of interferences of long periods on the structure of high polymers. Short abstracts are given, the full papers will be published in various German scientific journals.
(*Kunststoffe*, 1956/Aug./362.)

PLASTICS
IN THE SERVICE OF MAN

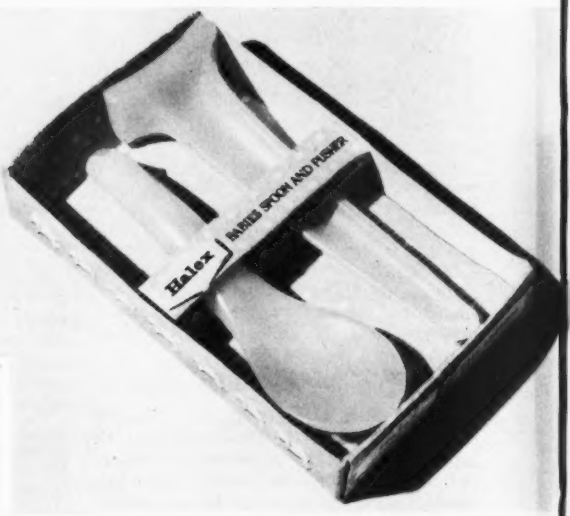
A pictorial review of high-quality units moulded or otherwise fabricated in Great Britain . . .

68. Plastics in the Nursery-I

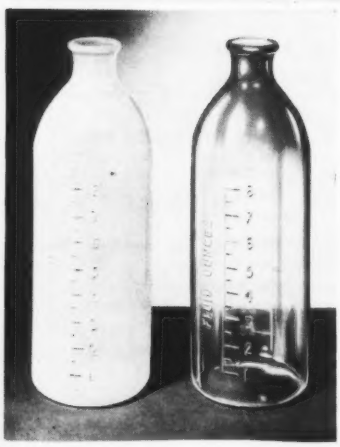
A list of trade-marks and companies mentioned in this review, with full names and addresses, appears on page 275

(Above) Polythene Plastapot injection moulded by E. K. Cole Ltd.

(Above) Soft toys slush-moulded in Geon p.v.c. by Mettoy Co. Ltd.



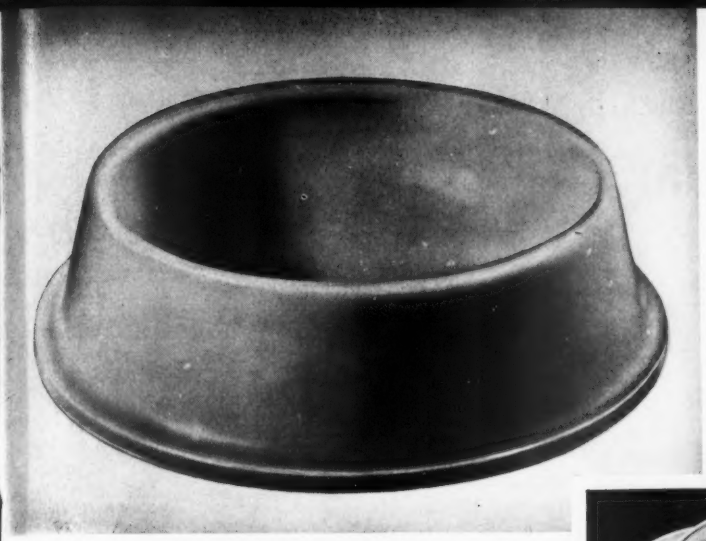
(Above) Polythene spoon and pusher, injection moulded by Halex.



(Right) Skylon polythene and nylon feeding bottles moulded by Fibrenyle Ltd.

(Right) A baby bath moulded in Alkathene and waste bin of plastics material.

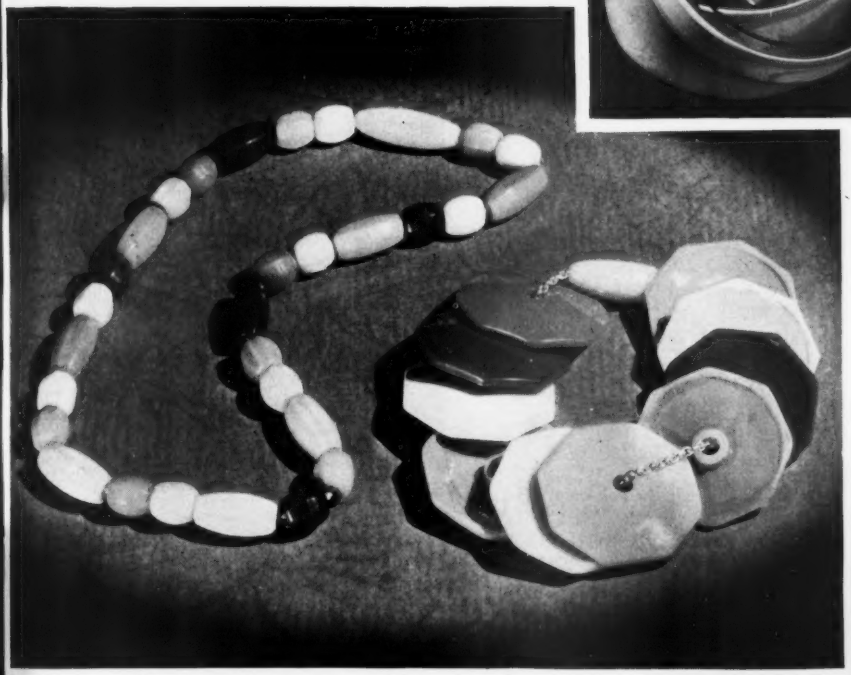
(Left) Nylon feeding bottles moulded by E. Shipton and Co. Ltd., and distributed by Industrial Appliances Ltd.



(Above) Feeding bowl moulded in polythene by E. K. Cole Ltd.

(Below) Baby powder puff packed in a Celastoid acetate box made by Chiltern Paper Products Ltd.

(Above) Part of the illustrated alphabet incorporated in Ware-rite panels in the children's playroom of the "Empress of Britain."



(Above) Teething beads and teething rattle moulded by Dandy Toys Ltd.

(Below) "Ducky" pot moulded in urea material by Aeroplastics Ltd. for Roy Aitken and Partners Ltd.

(Left) Pram rattle moulded in polythene by Rosedale Associated Manufacturers Ltd.

Farnborough 1956

A review of some of the interesting exhibits at the Society of British Aircraft Constructors Show

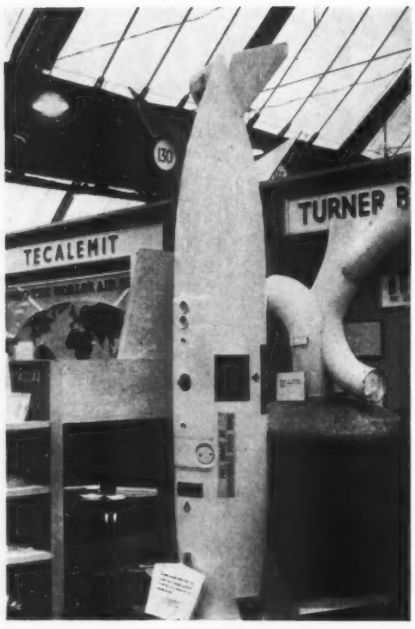


Fig. 1. Drop tank shown by Turner Brothers Asbestos Co., Ltd.

WHEN discussing the 1955 Farnborough scene last October we said that the aircraft industry as a whole appeared to be taking stock. For that reason, new developments were few in number, and there was little startling to report from the plastics industry's point of view.

This is virtually true for 1956; the contribution of our industry to aircraft is as great as ever, but it is essentially a consolidating process, without any particularly exciting high spots. The trend is definitely towards the wider usage of existing materials within certain clearly defined fields of application. Acrylics, glass and asbestos reinforced materials, p.t.f.e., impregnated and laminated wood, polythene, and the traditional moulding materials, are all playing their part.

In reviewing the 1956 show, therefore, we have selected a number of applications which appear to pinpoint these basic trends, since it seems that the usage of plastics by the aircraft industry will be principally in these fields.

Reinforced Plastics

The principal usage of reinforced plastics on show was in the manufacture of drop tanks. This application has now become familiar to visitors to Farnborough. Fig. 1 shows a tank manufactured by the Bristol Aircraft Company from Durestos asbestos/phenolic material made by Turner Brothers Asbestos Co., Ltd. This tank is of 50 gallons capacity. Behind it is a specimen duct unit in Duraglas glass/polyester.

By contrast, in Fig. 2 is a similar tank, of 90 gallons capacity, made by Marston Excelsior Ltd. This has been fabricated in glass/polyester. A similar kind of moulding was shown on the stand of Fibreglass Ltd., a camera cowling made by Martin Coachwork Ltd., for the Atomic Energy Research Establishment. The cowling (Fig. 3) is designed to protect the camera from heat and blast.

Other manufacturers of reinforced plastics materials showing at Farnborough were F. G. Miles Ltd., who exhibited a 100-gallon drop tank constructed on a unit basis, Ashdowns Ltd., who showed ducting for the Hunting Percival (Fig. 4) made from glass/polyester and honeycomb, and Thermo-Plastics Ltd.

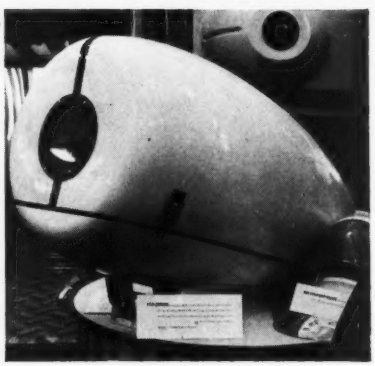


Fig. 3. Glass-reinforced polyester cowling to house a camera, made for A.E.R.E., and shown by Fibreglass Ltd.

Laminated Wood

Hordern-Richmond Ltd., had their usual display of laminated and impregnated wood jigs and tools. In Fig. 5 can be seen a nose rib forming tool for Scottish Aviation Ltd. Operated by a rubber press, the tool is designed to clamp the metal blank round its periphery, at the same time permitting the metal to flow rather than buckle in assuming the shape of the punch. A nose rib incorporating sharp curvatures is simply made with the aid of this tool. Hordern-Richmond also showed a helicopter blade built on the laminated wood principle. This had undergone

Fig. 2. Drop tank on the stand of Marston Excelsior.

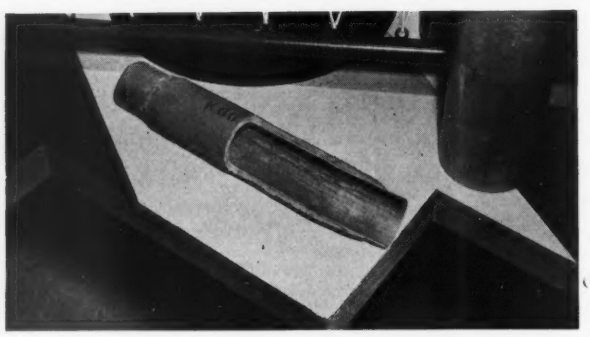


Fig. 4. Ducting for Hunting Percival.

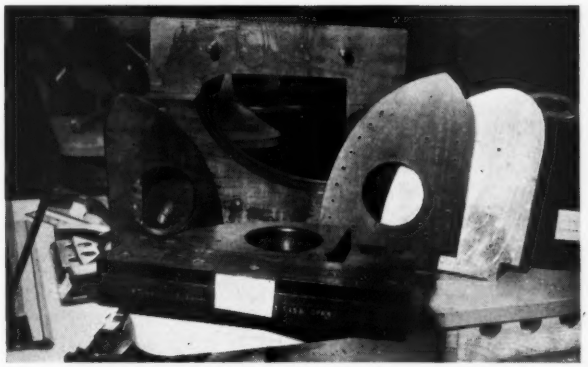


Fig. 5 (Left). Metal forming tool shown by Hordern Richmond Ltd.

Fig. 6 (Right). Acrylic aircraft components shown by Suntex Safety Glass Industries Ltd.

Fig. 7 (Below). Stand of Bakelite Ltd.

exhaustive tests, successfully, prior to being shown at Farnborough.

Many other jigs and tools in laminated wood, used by the aircraft industry, were shown.

Acrylics

Cast and welded acrylic tubes were a feature on the stand of Suntex Ltd., and some examples are shown in Fig. 6. Also shown in the photograph are examples of Perspex fabrications for lamp covers and other aircraft fixtures. Perspex was also, of course, featured on the stand of I.C.I.'s Plastic Division.

Expanded Materials

Expanded materials generally were the subject of the display by Jablo Plastics Industries Ltd. Of special interest was the expanded polystyrene, Jablite, moulded to enclose pipes. Assemblies for providing insulation round bends were also available, and it would seem that this " pre-fabricated " system for pipe insulation will interest many industries as well as the aircraft.

General

Bakelite Ltd. (Fig. 7), showed the full range of the materials manufactured by the company finding application in the aircraft industry, with special emphasis upon the glass/polyester aspect. Bowden (Engineers) Ltd., made a special display of p.t.f.e.

extruded tubing, now creating great interest by virtue of the non-wetting, non-sticking and zero water absorption characteristics of the material.

LETTERS TO THE EDITOR

Correspondents are reminded that a stamped addressed envelope should be enclosed in all cases where a personal answer is desired. It is understood that any letter received may be published at the discretion of the Editor.

Extruded Bottle Equipment

SIR —We would appreciate your help in locating an English manufacturer who is offering equipment for extrusion of polyethylene bottles, as the British Consulate in New York was unable to help us.

EXTRUDO-FILM CORPORATION.
36–35, 36th Street,
Long Island City 6,
N.Y.

Gum Coating Machinery

SIR,—We wish to ask your advice in connection with the manufacturers of machinery used for coating Cellophane sheets with gum prior to slitting. As you know, " Scotch Boy " and similar cellulose tapes are slit from the reel, and the reel is run through some kind of coating machine beforehand. We want to reach the manufacturers of this kind of coating machine, and any assistance you can give would be greatly appreciated.

BUREAU OF METALLURGICAL RESEARCH.
Suffolk House,
Suffolk Street,
Birmingham, 1.

Jets

SIR,—We have received an inquiry for various-coloured Telcothene injection moulded jets but have found that the Telegraph Construction & Maintenance Co., Ltd., do not hold a tool for producing these.

Will you kindly advise us whether you know the manufacturer of such jets, so that we may satisfy our customers' requirements.

GRIFFIN & GEORGE LIMITED.
Ealing Road,
Alperton,
Wembley,
Middlesex.

Extrusion of P.V.C.

SIR,—It has come to our attention that a process has been devised to enable cables to be covered with p.v.c. without the use of an extruder. We wondered if you had any information on this subject.

The information is that the cables are passed through a bath of p.v.c. mastic (hot) and are then snuggered down to a required diameter through a sizing die. Another process is where the cable is lapped with p.v.c. tapes, is then passed through a bath of hot p.v.c. and then sized through a die.

The obvious suggestion is that the process employs p.v.c. paste which, of course, it may well do. However, there does seem to be some suggestion in the information that a bath of hot p.v.c. is being used, and we should like information on both aspects.

JOHNSON & PHILLIPS, LIMITED.
Charlton, London, S.E.7.

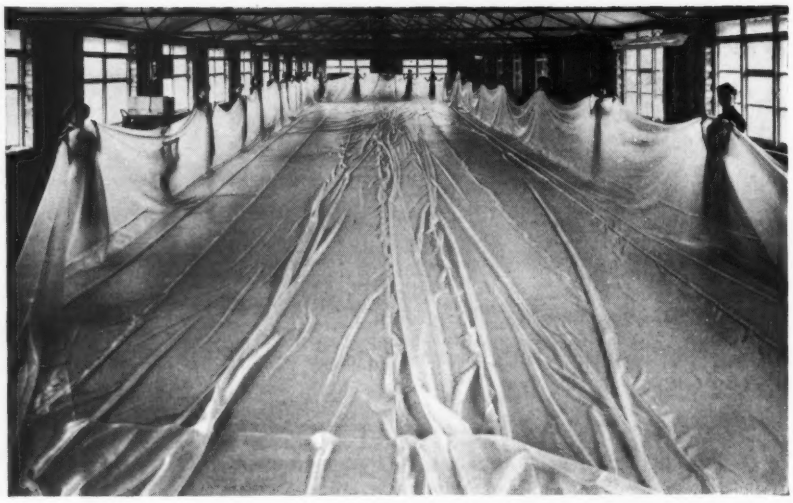
New Productions

P.V.C. Aprons Save Petrol

Large p.v.c. aprons, each measuring 120 ft. × 30 ft. and weighing nearly half a ton, have recently been made for the Ministry of Supply for lining test areas where petrol tanks of up to 30,000 gallon capacity are subjected to impact and other tests. In use, the aprons are draped inside and over the sides of a sandbagged dispersal, and their purpose is to prevent the wastage of large quantities of petrol in the event of a tank bursting or splitting.

The aprons were welded from Vybak VB.177 sheet of 0.020 in. thickness by Plysu Products Ltd., Woburn Sands. This special grade of p.v.c. sheeting makes use of a polymeric plasticizer, and is thus resistant to the solvent action of petrol, which is liable to leach out conventional plasticizers.

The aprons were made by welding sheets of Vybak together using an RF welder mounted on a wheeled chassis. Two operators were involved in the fabrication, one guiding the p.v.c. sheet, the other manipulating the RF welder. Vybak VB.177 p.v.c. sheet is supplied by Bakelite Ltd.



A large p.v.c. apron used for lining test areas where petrol tanks are subjected to impact and other tests.

Interlocking Bath Mat

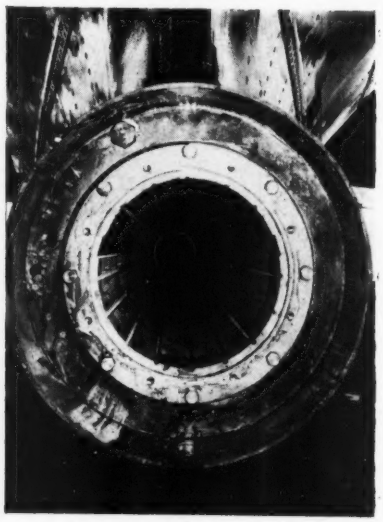
The new product of Barclay-Stuart (Plastics) Ltd., 25–27 Brunswick Street, Luton, Beds., which will be appearing in the shops this month, is the novel bath mat which we illustrate. The various sections of different colours can be made up into a variety of shapes and patterns to suit most colour schemes and bathroom layouts. The sections are injection moulded in polythene. Barclay-Stuart (Plastics) Ltd., have the patent rights of this product for this country.

Laminate for Stern Tube Bearings

Tufnol Ltd. of Perry Barr, Birmingham, have for some considerable number of years been manufacturing the well known Tufnol laminates for the shipping industry. Originally this material was used as rudder bearings where it achieved a considerable success because of its hardwearing and corrosion resistant qualities. Over 100 ocean-going ships have been fitted with this type of bearing since 1949, none as yet having been replaced due to normal wear.

The latest application of this material is in stern tube bearings and our photograph shows one of these which is being fitted to the M.V. "Andre Masset," a 5,600 ton bulk carrier. Beside the two properties given here Tufnol has the additional advantages of having a very low water absorption figure and will not crack or warp.

One example of the hard-wearing qualities of Tufnol is that in one ship the wear on the stern tube bearings amounted to .045 in. in two years. During its previous 20 years of service this ship had to be "rewooded" every year.

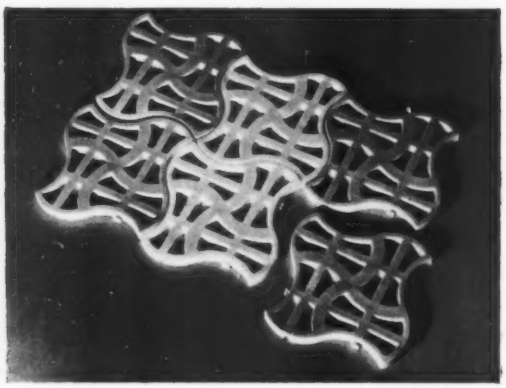


A Tufnol laminate used as a stern tube bearing.

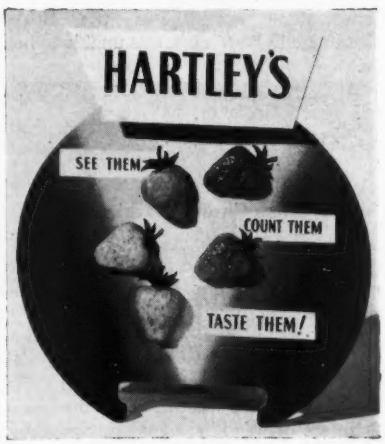
Three-Dimensional Displays

An effective point of sale display for Hartley's jams and marmalade are now appearing in retail shops. In the form of jar crowners, the displays feature life-like imitations of the particular fruit contained in the jam or marmalade, set against an appropriate coloured background. Projecting through cut-out shapes in the board are the coloured vacuum formed acetate fruit shapes—orange slices, strawberries, etc.—which give the display a three-dimensional effect.

The displays were designed and produced for W. P. Hartley Ltd. by E. S. & A. Robinson Ltd., Redcliffe Street, Bristol, 1.



(Left) Injection moulded polythene sections used to form the interlocking bath mat.



(Right) Vacuum formed acetate provides the three-dimensional effect on this display card.

Plastics NEWS

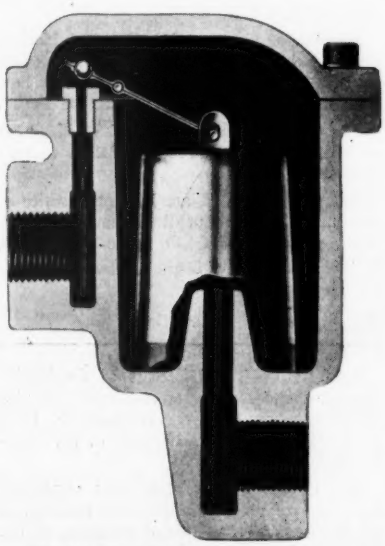
Plant and Equipment, Materials Processes, Company News, Technical Literature, Exhibitions, Personal Notes, and Meetings

PHENOLIC COMPOUNDING MACHINERY.—A process for compounding phenolic moulding materials which eliminates the necessity for using rolls has been developed in the U.S.A. by Beardsley and Piper, 2424 North Cicero Avenue, Chicago 39, Illinois. It is claimed that by using the Speed Densifier process a saving of five cents or more per pound is made through its effective mixing and densifying action.

The ingredients, filler, lubricant, dye and resin (if in powder form) are loaded into the Speed Densifier where they are heated and undergo a mulling action. For general purpose material using a wood flour filler, the cycle time is 3 to 5 minutes. Where fibrous fillers are used the liquid resin can be injected into the Densifier, under pressure and the unit can be adjusted so as not to destroy the fibre length.

A p.v.c. compounding machine is also produced by the same firm in which after loading with resin, pigment, plasticizers, etc., hot air is blown through during mixing. This machine, known as the Speedmullor, has a capacity of 1,200 lb. per hour.

STEAM TRAP.—Lancaster & Tonge Ltd., of Pendleton, Manchester, have introduced a new inverted bucket type steam trap. The trap is designed so that when steam enters the float, the water inside is displaced so that the float becomes buoyant, rises and closes the valve. The valve remains closed until more condensate enters the float, forcing the steam, which has previously been in the float, through the small vent hole. The float, thus loses its buoyancy and begins to sink, pulling on the lever as it does so. The lever pivots on the primary fulcrum exerting a very big pull on the valve due to the extraordinary leverage which the float has over the valve. This cracks the valve open against the pressure inside the trap and as the float falls still further, the lever pin engages the bottom of the slot in the lever bracket when a much smaller leverage pulls the already opened valve well away from its seating.



The Lancaster & Tonge Ltd. steam trap.

LABORATORY PRESS.—Designed for use in the laboratory for testing materials or mould design, the 10-ton Universal press made by Apex Construction Ltd., 15 Soho Square, London, W.1, can be used for many other applications. By the addition of suitable equipment, laminating, extrusion, and pelleting can easily be accomplished.

The press has its own hand operated pump and oil storage chamber and is constructed of cast iron and steel with a rising bottom table. The platen size is 6 in. × 7 in. the top platen being easily set by hand. In the laminating press, illustrated, there is 1½ in. of daylight between the platens which are electrically heated. Normal daylight is 16 in. Full details on the equipment available and the different types of presses including four column and 20-ton units are available from the manufacturers.

General

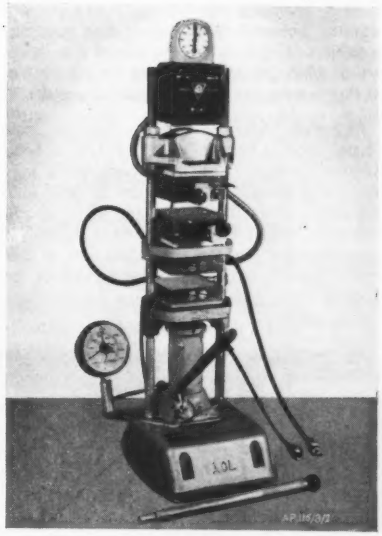
Flexible Printed Circuits.—To overcome some of the problems in the production of small and complex electronic circuits, Sanders Associates Inc., Nashua, New Hampshire, U.S.A., have produced specialized circuits printed on Kel F film. By using flexible circuits it has been possible to produce triplane circuitry and a considerable reduction in space and weight has been achieved. Other examples of its use include cable form either as a single layer or as a laminate. In the latter case it is necessary, in order to prevent voltage breakdown, for the conductors to be staggered. Operating temperatures of up to 125° C. and in some cases even higher can be safely maintained with this type of circuit.

Raw Materials Plant.—Monsanto Chemicals Ltd. plan to spend some £8½m. on the first stage of a long term expansion programme. A new factory is to be constructed on a 100-acre site at Fawley, Hampshire, alongside the Esso refinery from which it will draw feedstock.

The first plant to be erected will be for the manufacture of 10,000 tons of polythene a year. Production is scheduled to start in 1958.

The next products in the company's programme will be copolymers of acrylonitrile, butadiene and other monomers, and following this a major plant is to be constructed for the manufacture of acrylonitrile.

Extruded Polystyrene Copolymer Sheet.—Erinoid Ltd., Stroud, Gloucester, announce the production of extruded polystyrene copolymer sheet. Two finishes are obtainable, the matt/matt finish and the high gloss laminate polish/matt finish. In the former the maximum width is 60 in., length 96 in. and the thickness range from 0.010 in. to 0.190 in. The polish/matt finish is obtainable in maximum widths of 40 in., length 96 in. and a thickness range from 0.040 in. to 0.190 in. Greater widths are not possible owing to the limitation of the polystyrene foil used in the laminating process. The new grade of sheet is known as Erinoid CP.20X and is the widest extruded sheet manufactured in this country.



The Apex laboratory laminating press.

Irradiated Polythene Tape.—Tube Investments Ltd., announce the development of a range of irradiated polythene tapes for industrial and packaging applications. Among the advantages in using this tape are its increased temperature resistance and elastic memory. The latter property can be advantageously used for encapsulating in the packaging field.

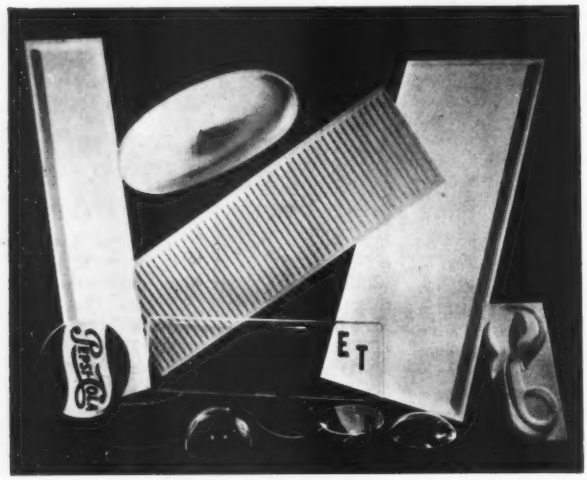
Liquid Oxygen Hose.—A new flexible hose for conveying liquid oxygen, which is claimed to have a number of important advantages over the metallic flexibles used previously, has been produced experimentally by the Flexibles Advisory Service of Compoflex Co. Ltd., 23–25 Northumberland Avenue, London, W.C.2. Liquid oxygen has a temperature of —183° C.

The hose consists of an inner wire spiral of 12 gauge stainless steel; lappings of square-woven 10–12 oz. Terylene fabric; layers of Terylene film (Melinex); further layers of Terylene fabric and an outer wire helix also of 12 gauge stainless steel. The number of layers of film and fabric used in the hose make-up depends on the working pressure required, but the wall thickness would be at least ¼ in. for a low pressure hose. For working pressures over 500 p.s.i. the hose would have an additional outer braiding of stainless steel.

Barrel Finishing Polyester Buttons.—Lacrinoid Products Ltd., Gidea Park, Essex, have published the results of their research into the barrel finishing of polyester buttons. Good results have been obtained for both finishing and polishing. By using the Lacrinoid Finishing Balls barrel loads could be maintained at very economical levels and results obtained in reasonable running times depending on pre-barrelling conditions. As no dressing of the

balls is necessary no cleaning operation was required between the finishing and polishing processes. For polishing the use of ¼ in. hardwood cubes impregnated with Lacrinoid No. 10 Polish gave the best and quickest results.

Extruded Acrylic Sheet.—The Cadillac Plastic and Chemical Co., 15111 Second Avenue, Detroit 3, Mich., announce the production of extruded acrylic sheet in .060, .080, .100 and .125 in. thicknesses and 49 in. width. The price, which varies on quantity bought, is approximately ⅓ of the equivalent cost of cast sheet. Reports indicate that the quality of the sheet is very good and it has an excellent surface finish.



Some examples of fabrications from extruded acrylic sheet.

Agreement.—An agreement between A.K.U. of Arnhem, Holland, and Spencer Chemical Co. of Kansas City, U.S.A., has been reached whereby Spencer Chemical Co. will produce nylon 6 from caprolactam. A plant for its production is expected to be completed in the summer of 1957.

Correction.—On page 226 of the September issue of *Plastics* reference was made to the accuracy of inductances on the ECME machine. The figure quoted should have been ± 0.5 % and not ± 5 %. Photographs in that article are acknowledged to the Central Office of Information.

Organo-Silicon Size for Glasscloth.—Midland Silicones Ltd. have announced that a new organo - silicon glasscloth size has been developed by their associate company, Dow Corning Corporation. A preliminary evaluation has been carried out on it in the laboratories of Midland Silicones Ltd. to assess the performance of the product in combination with British made resins.

Literature

New Standards for P.V.C.—Two standards have recently been introduced by the British Standards Institution, 2 Park Street, London, W.1, for flexible and unsupported p.v.c. sheet. The first B.S. 1763:1956 is for thin sheet from 0.004 in. up to 0.015 in. thick and constitutes a complete revision of the standard published in 1951. The revised items include requirements for embossed, laminated, and flame-resistant sheeting and increase in standard temperature from 20° C. to 23° C. The method of measuring thickness and several test methods have been revised so that whenever possible the same methods can be used for thin and thick sheeting of all types. A further section on labelling with suggested wordings has been added and it is hoped that sheet manufacturers and fabricators will adopt this informative labelling suggestion.

B.S. 2739:1956 is an entirely new standard dealing with unsupported p.v.c. sheet within the thickness range from 0.010 in. to 0.035 in. inclusive. Fourteen tests are given in the specification for both printed and plain material and also a section, similar to B.S. 1763, is devoted to informative labelling.

The adoption of these specifications by British manufacturers will provide customers with a material of a quality as high as, if not higher than, any produced in the world.

Company News

West Instrument Ltd. have opened a sales and service office at 25A Cockspur St., London, S.W.1. Mr. H. W. Barnett has been appointed manager.

Anglo Scottish Chemical Co. Ltd. have been appointed the representatives for Scottish Sales for Hess Products Ltd. and A. Hess & Bro. Ltd. apart from the paint and printing ink trades.

Firth Brown Tools Ltd. have opened a warehouse at 2 Warwick Place North, Warwick Way, Victoria, London, S.W.1.

Hess Products Ltd., and A. Hess & Bro., Ltd., opened a Birmingham office at 191 Corporation Street (Telephone Central 3891).

Petrochemicals Limited to Produce Styrene Monomer.—At a cost of £1,750,000, a new plant for the production of styrene monomer is to be built by Petrochemicals Limited, a wholly owned subsidiary of the Royal Dutch/Shell Group. The plant will be at Partington on the Manchester Ship Canal and is expected to be in operation during 1958.

A considerable part of the styrene monomer output will go to Styrene Products Limited, a Petrochemicals Ltd. associate, for the manufacture of polystyrene moulding powders.

It is from this plant also that the International Synthetic Rubber Consortium will draw substantial quantities of styrene for the manufacture of synthetic rubber at Fawley. Further quantities will be available for sale to industry in general.

Rapid Magnetic Machines Limited, Lombard Street, Birmingham, announce the establishment of a department specializing in the problems of automation and the utilization of magnetic power.

Dow Chemical Company has purchased two 2-million-volt Van de Graaff particle accelerators for basic studies in radiation chemistry.

T. H. & J. Daniels Ltd. announce that they acquired the Latymer Engineering Co., together with manufacturing and selling rights of the range of vacuum forming equipment. All enquiries should be addressed to T. H. & J. Daniels Ltd., Stroud, Gloucestershire.

Plastics Institute.—The Silver Jubilee Ball will be held at the Savoy Hotel on October 25. The following day an education conference will be held at the Borough Polytechnic.

Borax Consolidated Ltd. have increased the price of their chemical products by £1 per ton as from October 1. However, the company have announced that unless exceptional circumstances arise, they intend stabilizing these new prices until at least March 31, 1957.

High Voltage Engineering Corporation announce the appointment of the Leybold organization of Koln-Bayental, Germany, as German sales representatives for the Van de Graaff machines.

Battelle Institute Ltd.—The registered offices of the institute are now at 24 Ryder Street, St. James's, London, S.W.1. Telephone No.: Trafalgar 1621.

British Oxygen Form Research and Development Subsidiary.—British Oxygen announce that a new private company, to be known as British Oxygen Research and Development Limited, has been registered and came into existence on October 1.

The Board of the new company will be: Dr. P. H. Sykes (chairman), Dr. N. Booth (managing director), and Dr. L. C. Bannister.

Exhibitions

Packaging Exhibition.—The exhibition is to be held at Olympia from January 22 to February 1, 1957.

Engineering, Marine, Welding and Nuclear Energy Exhibition.—This exhibition which now includes nuclear energy in its title will be held at Olympia from August 29 to September 12.

Travelling Exhibition.—Lorival Plastics have built a travelling exhibition which is to tour industrial centres.

George Ellison Ltd. are holding a series of exhibitions throughout the country demonstrating their new GEO range of medium voltage electric switchgear.

Personal

Lord Reith.—The Directors of the British Oxygen Company Limited announce that at a Board Meeting held on September 5, Lord Reith was appointed a Director of the Company.

Mr. C. W. Johnson has been appointed supervisor of polymer application research in the plastics and polymers department of the Food Machinery and Chemicals Corporation,

Chemicals Research Centre. **Mr. D. Warren** has joined the polymer application section of the plastics and polymers department of the FMC Chemicals Research Centre. **Mr. B. L. Gilbert** has taken charge of applied radiochemical research at the FMC Chemicals Research Centre.

Mr. A. J. Brunker, the Chief Engineer of E. K. Cole Ltd., has been appointed an Executive Director of the Company.

Mr. S. C. Stewart.—The Carbon Dioxide Company (a Division of the Distillers Company Limited) announces the appointment of Mr. S. C. Stewart as Director in Charge of the Division.

Mr. Stewart, who has been a Division Director of The Carbon Dioxide Company for some years, is General Manager of the Industrial Alcohol Division, and a Division Director of British Industrial Solvents Division, of D.C.L.

Dr. H. W. Melville has taken up his appointment as Secretary of the Department of Scientific and Industrial Research.

Dr. G. B. B. M. Sutherland has taken up his appointment as Director of the National Physical Laboratory.

Mr. W. Morgan Thompson, sales director of Monsanto Chemicals Limited, has been appointed a director of Monsanto Plastics Limited.

Mr. W. J. Parker has recently joined the staff of Mervyn Instruments of Woking.

Golf Results.—The P.I.G.S. results of the meeting at Swinley Forest Golf Club on August 28, were:

" Australian Shield " (Medal).

Winner:

T. S. Crabtree (13) .. .. 84 = 71 nett

Runner-up:

J. N. Smith (5) .. .. 77 = 72 nett

Special Prizes (Stableford Greensomes).

Winners:

C. W. Thomas (11) .. } 39 points
P. L. W. Morton (18) }

Runners-up:

P. Smith (7) .. .. } 38 points
P. J. L. Attwood (24) }

Results of the P.I.G.S. meeting at West Hill on September 18, were as follows:

" Artid " Trophy (Handicap)

Winner:

J. G. H. Jamieson (13) .. .. 71 nett

Runner-up:

G. F. Hunt (16) .. .. .. 72 nett

" I.C.I." Trophy (Scratch)

Winner:

W. A. Evans (5) .. .. .. 74 gross

" Rootes " Prize (Stableford Bogey Foursomes)

Winners:

D. Brooke-Hitching (10) } 39 points
L. Pendry (24) .. .. }

Runners-up:

P. Morgan (24) .. .. } 37 points
L. Hill (20) .. .. }

Mr. J. W. Hewitt has recently taken up an appointment as Technical Assistant to the Managing Director at Petmar Industries.

Mr. L. Drucquer has been appointed a Director of The British Thomson-Houston Company, with special responsibility for Home Sales.

Mr. Drucquer is also a Director of the Switchgear Testing Co., Manchester.

Mr. F. J. Moss and **Mr. R. O. Hughes** have been appointed directors of P.D.I. Limited. Mr. Moss was formerly works manager and Mr. Hughes commercial manager.

Mr. G. Dring, Research director of Bakelite Ltd., has been elected to serve on the General Council of the British Standards Institute.

Mr. R. A. Briginshaw.—It is with regret that we hear of the death of Mr. R. A. Briginshaw, who has been with The Micanite and Insulators Co. for 19 years. He was 59 years of age.

Meetings

October

12th.—Autumn Dance. Plastics Institute, Midland Section. Botanical Gardens, Birmingham.

12th.—Works Visit. Styrene Products and Petrochemicals Ltd., Partington Industrial Estate, Manchester. Plastics Institute, North-Western Section. 2.30 p.m.

17th.—" Raw Materials," M. D. Curwen, B.Sc., A.R.I.C. Plastics Institute, London Section. National College of Rubber Technology, Holloway Road, N.7. 6.30 p.m.

17th.—" High Temperature Insulating Materials in Aircraft," H. Wood. Plastics Institute, North-Eastern Section. Eldon Grill, Grey Street, Newcastle. 7 p.m.

17th.—Film Evening. Plastics Institute, Scottish Section, Glasgow.

18th.—" Steam for Process," L. G. Northcroft, O.B.E., B.Sc.(Eng.), M.I.Mech.E., M.I.H.V.E., F.I.Plant.E. Incorporated Plant Engineers, Blackburn Branch. Golden Lion Hotel. 7.30 p.m.

19th.—" Plastics in Surgery," J. T. Scales, M.R.C.S., L.R.C.P. Plastics Institute, Midlands Section, The James Watt Memorial Institute. 6.30 p.m.

22nd.—" P.V.C. Compoundings," S. Mottram, A.I.R.I. and D. A. Lever. Plastics Institute, London Section, The Lecture Hall of the Royal Society of Tropical Medicine and Hygiene, 26 Portland Place, London, W.1. 6.30 p.m.

25th.—" Compressed Air—Its Application," D. Moreton, M.I.Plant E., Incorporated Plant Engineers, London Branch, College of Preceptors, Bloomsbury Square, W.C.1. 6.30 for 7 p.m.

25th.—" A Practical Approach to Industrial Electronics," A. M. Lock. Incorporated Plant Engineers, Sheffield Branch, The Grand Hotel, Sheffield. 7.30 p.m.

25th.—" Plastics in Boats," H. A. Collinson, F.R.I.C., A.P.I. Plastics Institute, Southern Section, The Chemistry Department, The University, Southampton.

26th.—" Electroformed Moulds," P. Spiro, and " Precision Casting to the Plastics Industry," A. Torry. Plastics Institute, North-Western Section, Engineers' Club, Albert Square, Manchester 2. 6.45 p.m.

26th.—Dinner Dance: Incorporated Plant Engineers, Birmingham Branch, Leofric Hotel, Coventry. 7.30 p.m.

26th.—" Any Questions ? " Joint Meeting with Bristol O.C.C.A. The Birmingham Paint Varnish and Lacquer Club, Bristol.

26th.—Annual Dinner. Incorporated Plant Engineers, Western Branch, Grand Hotel, Bristol. 7.15 p.m.

November

1st.—" Continental Uses of Synthetic Resins," L. P. Edel, Ph.D. (Holland). The Birmingham Paint Varnish and Lacquer Club, Imperial Hotel. 6.30 p.m.

6th.—" The Use of Radio Isotopes in Industry," C. W. Jones, B.Sc., A.M.Inst.P., Incorporated Plant Engineers, London Branch, Royal Society of Arts, John Adam Street, Adelphi, Strand, W.C.2. 6.30 for 7 p.m.

7th.—" Process Steam," L. G. Northcroft, O.B.E., B.Sc.(Eng.), M.I.Mech.E., M.I.H.V.E., F.I.Plant E. Incorporated Plant Engineers, Leicester Branch, Bell Hotel, Leicester. 6.30 p.m.

8th.—" An Introduction to Atomic Energy," J. A. Dixon, M.A. Incorporated Plant Engineers, Glasgow Branch, Scottish Building Centre, 425/427 Sauchiehall Street. 7.15 p.m.

8th.—Annual Luncheon, Plastics Institute, London Section, Grand Hall, Criterion Restaurant, Piccadilly, London, W.1.

9th.—" The Industrial Application of Terylene Polyester Fibre," E. D. Rossiter, M.A., B.Sc., Plastics Institute, North-Western Section, The Stork Hotel, Liverpool.

12th.—" Low Pressure Polythene," Dr. Grams. Plastics Institute, Midlands Section, Grand Hotel, Leicester. 6.45 p.m.

14th.—" Instrumentation in the Plastics Industry," J. A. Dugon. Plastics Institute, Western Section, joint meeting with the Glos. Engineering Society, The Wheatstone Hall, Gloucester. 7 p.m.

14th.—" Spark Machining in the Field of Die Making," A.D.P. Tallents. Plastics Institute, Yorkshire Section, St. Marks House, 186 Woodhouse Lane, Leeds.

14th.—" Microscopy and Electron Microscopy," T. S. Millen. Plastics Institute, South Wales and Monmouthshire Section, Angel Hotel, Cardiff. 7 p.m.

14th.—" Materials Handling," J. G. Parkes. Incorporated Plant Engineers, Western Branch, Grand Hotel, Bristol, 7.15 p.m.

" Plastics in the Service of Man "

The following is a list of full names and addresses of companies mentioned in the illustrated feature, " Plastics in the Service of Man," which appears on pages 268 and 269 in this issue:—

68. Plastics in the Nursery—1

Aeroplastics Ltd., Earl Haig Road, Hillington, Glasgow, S.W.2.

Aitken, Roy, & Partners, Ltd., 10 Stratford Place, London, W.1.

Alkathene—I.C.I. Ltd., Plastics Division, Welwyn Garden City, Herts.

Celastoid—British Celanese Ltd., Celanese House, 22/23 Hanover Square, London, W.1.

Chiltern Paper Products Ltd., Belswains Lane, Nash Mills, Hemel Hempstead.

Cole, E. K., Ltd., Ekco Works, Southend-on-Sea, Essex.

Dandy Toys Ltd., 49 South End, Croydon, Surrey.

Fibrenyle Ltd., 157 Dukes Road, Western Avenue, London, W.3.

Halex, Higham's Park, London, E.4.

Industrial Appliances Ltd., 21 Grosvenor Street, London, W.1.

Mettoy Co., Ltd., The, Queensway, Fforestfach Trading Estate, Swansea.

Rosedale Associated Manufacturers Ltd., 11 Upper Grosvenor Street, London, W.1.

Shipton, E., & Co., Ltd., Ferndown, Northwood Hills, Middlesex.

Warerite Ltd., Watton Road, Ware, Herts.

TALKING SHOP . . .

Stockholm Exhibition and Convention. The Swedish Plastics Federation will have its annual meeting from October 27 to November 4. The exhibition will cover 21,000 sq. ft. At the convention speakers from 14 countries will read papers on a wide range of topics. They will be delivered in English, Swedish and German. Amongst the 83 speakers are D. Radford, E. K. Cole Ltd.; D. Mahon, Bakelite Ltd.; M. Jones, I.C.I. Ltd.; P. G. Pentz, Leicester Lovell and Co. Ltd.; Dr. S. J. Skinner, British Geon Ltd.; H. Verity Smith, Pure Chemicals Ltd.; B. Parkyn, Scott Bader and Co. Ltd.; A. H. Woodfull, B.I.P. Ltd.; M. G. Burges-Short, T. H. and J. Daniels Ltd.; A. Beecham, Courtaulds Ltd., and M. D. Curwen, Editor of *Plastics*.

* * *

Tred. The other day we were invited by Monsanto Chemicals, Ltd., to a one-day symposium on the company's research laboratories at Fulmer, on Tred 50 and Tred 85, new rubber reinforcing resins. Tred 85 consists of 85 parts of styrene to 15 parts of butadiene, whilst Tred 50 contains 50 parts styrene to 50 parts of butadiene. Prices are expected to be 3s. 3d. and 2s. 6d. a pound respectively.

These are, of course, primarily resins for use in conjunction with rubber and the first and major outlet will be in the footwear industry for shoe soles. A new plant at present in course of completion at Newport will produce 4,500 tons of these copolymers a year.

Although for plastics purposes Tred resins cannot be injection moulded they are suitable for incorporation with ebonite. A rather lower sulphur content is employed than is normal with ebonite and a range of attractively coloured models can be obtained without high loading of white pigment and consequent reduction in strength characteristics. Mouldings of this kind have been found to give a maximum service temperature of 170°–175° F. and applications already envisaged include sink tidies, TV escutcheons and sockets and plugs.

* * *

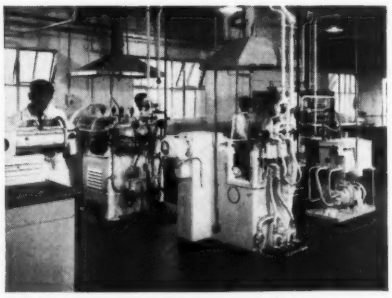
Caravans in Glass. Rarely a month goes by (or so it seems) without the advent of a new caravan constructed in glass-fibre polyester materials. Within limits we do our best to keep pace with this fast moving branch of the coach building industry. The latest in the field is the " Carola," manufactured by The Watling Joinery Works. Some photographs illustrating this particular caravan are shown below.

" Carola " was unveiled in all her glory by British Resin Products, Ltd., at the Molesey sportsgrounds of the Distillers Company a few days ago. It is constructed from two mouldings, each reinforced with glass-fibre struts and measures 12 ft. overall. It has been designed for small car touring and the weight has been kept down wherever possible, with the result that the vehicle weighs 10½ cwt. ex-works.

Fabrication of the bodywork is carried out by Wemyss Woodhouse, Ltd., of Talbot Road, Rickmansworth, Herts, using polyester resin manufactured by British Resin Products, Ltd. A great deal of care seems to have been taken by both designers and fabricators to make the vehicle as strong and as durable as possible. The finish of the vehicle, internally and externally, was excellent.

* * *

New Laboratories for Pure Chemicals, Ltd. On September 26 the new laboratories of Pure Chemicals were opened at Kirkby, Lancashire. They have been established to provide a complete service to the vinyl plastics industry on stabilizer problems of all kinds. A photograph of the new laboratories appears on this page. As will be seen, they are very well equipped to deal on a practical scale both with problems raised by customers and also fundamental research on the mechanisms of stabilizer action. It is always gratifying to see from the development of research organizations of this kind, since it is only by this method that real progress can be made.



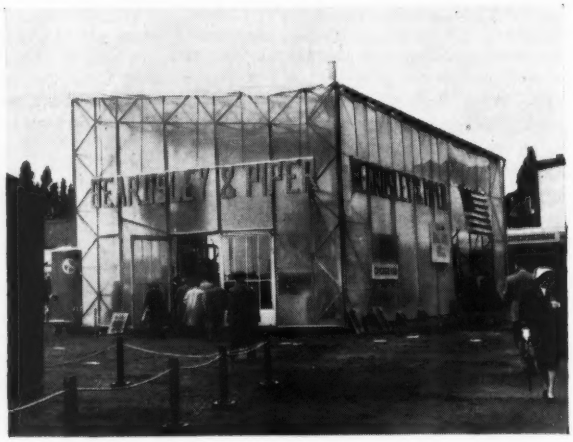
New Laboratories at Pure Chemicals, Ltd.

* * *

Low Cost Exhibition Buildings. A colleague of mine on our associate paper *Light Metals*, was recently in Düsseldorf to attend the International Foundry Exhibition. He brought back the photograph which I show here. Using tubular structural scaffolding as the framework, polythene sheeting has been employed as the glazing media for the walls. The exhibitors report that they were very pleased with this novel exhibition hall. The structure was cheap to erect, provided admirable light transmission and was easily assembled.

In this country of ours, where the monsoon lasts from April to September, flower shows, agriculture shows and even garden parties should be interested in this new approach to keeping dry.

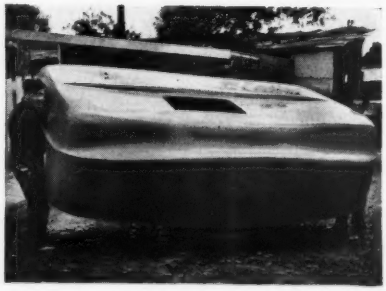
PLASTIKON.



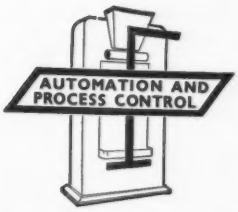
Steel scaffolding is used to support thin polythene film to form a low cost, easily assembled exhibition building. This photograph was taken at the recent Foundry Show at Düsseldorf.

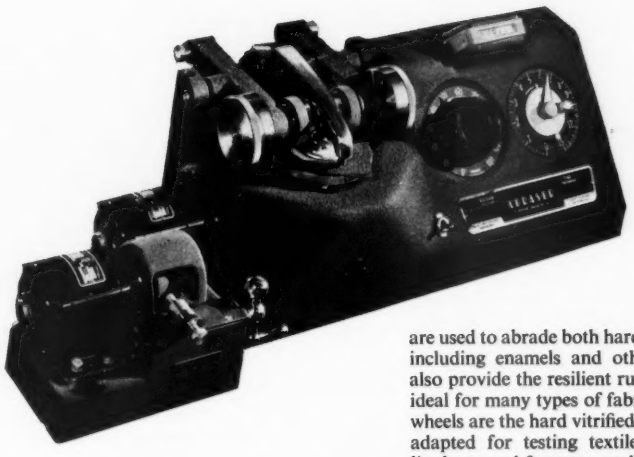
(Left) " Carola," a new caravan constructed from glass reinforced polyester materials.

(Right) A typical moulding for this caravan. Internal reinforcement is provided by glass/polyester ribs.



Automation Equipment





The Taber Model 140 abrasion tester and diamond refacer unit.

Abrasion Testing Set.—Taber Model 140 Abraser is a durable precision built test instrument designed to evaluate the resistance of surfaces to rubbing abrasion. Its range of application includes tests of painted, lacquered electro-plated surfaced and plastic coated materials, also textile fabrics ranging from sheer silks to heavy upholstery, leather, rubber and linoleum.

The test set has been accepted as standard by the automotive, aircraft, chemical, textile, paint and other principal industries, both in the United States and foreign countries.

The rotary rub-wear action used is the result of dual abrading wheels, one rubbing the specimen from the centre outward and the other from the outside toward the centre. The abrasion marks are in the form of two arcs crisscrossing each other and covering an area of approximately 30 square centimetres which is satisfactory for rating most materials. An important feature of the abraser is that the wheels traverse a complete 360° circle revealing abrasion resistance on the same specimen at all angles relative to the weave or grain of the material. Two sets of stainless steel weights, 500 and 1,000 grams, are furnished, which, in addition to the abrading arm itself (250 grams), provide three standard ranges of wheel pressures against the specimen.

Abrading wheels, designed to simulate many types of abrasion on a wide range of materials are available. The resilient Calibrase wheels are used to abrade both hard and soft materials, including enamels and other coatings. They also provide the resilient rubbing action that is ideal for many types of fabrics. The Calibrade wheels are the hard vitrified type which are best adapted for testing textiles, rubber, leather, linoleum and ferrous metals.

A variety of holders for different kinds of materials are available, such as the rimmed specimen holder that can be partially filled with a liquid to wet the specimen by absorption, or to completely submerge it during the abrasion test.

Additional equipment shown in the illustration is the diamond refacer used to true the Calibrade vitrified wheels and the Calibrase resilient wheels.

Funditor, Ltd., Woodbridge House, 3 Woodbridge Street, London, E.C.1.

Data Transmission Units.—It is announced that a new Anglo-American Company, Ketay Limited, has been formed for the production of precision synchros, servo motors, resolvers and tachometer generators for use in computers, radar sweep circuits, phase shifters and accurate data transmission systems.

Ketay Limited is a joint company formed by The Plessey Company, Limited, and Norden-Ketay Corporation of New York, U.S.A. The precision units will be produced to the specifications of The Plessey Company, Limited.

The synchros range from size 10 to size 31 and include all international size standards. There are units for every purpose including transmitters, control transformers, receivers and differential units and as special purpose devices, can be used for converting 3-phase data into 2-phase data.

Resolvers, or computing synchros, are available in sizes 10 to 23 in an exceptionally wide variety of types covering applications from Coarse ± 0.2% to Precision ± 0.05%.

Servo motors are available for 400 or 60 cycles as standards and for 50 cycles. These high torque to inertia servos range from size 10 to size 23 with torques of 0.1 in.-oz. to 7.5 in.-oz and tachometer generators are available for 60 and 400 cycle excitation with linearity of 0.1%. Zero speed voltages are held to 5 millivolt in phase, 5 millivolt quadrature and 15 millivolt third harmonic.

Directors of the new Company are A. G. Clark, E. J. Earnshaw and A. E. Underwood of The Plessey Company, Limited, and Mr. Morris F. Ketay of The Norden-Ketay Corporation, U.S.A.

Ketay Ltd., Eddes House, Eastern Avenue, West Romford, Essex.

A New Rodene Timer.—The illustration shows the Type 2500, a self-resetting process-timer (or synchronous time-delay unit) which has just been added to the Rodene range.

The dial has only to be handled when presetting a new timed period as the unit automatically resets when the mains are disconnected. Repetitive timing thus only necessitates turning the mains off and on.

The output switch (rating 5 amps) has a change-over action which allows the controlled circuit to be made either for the timed period, or from the end of the timed period and until the mains are switched off.

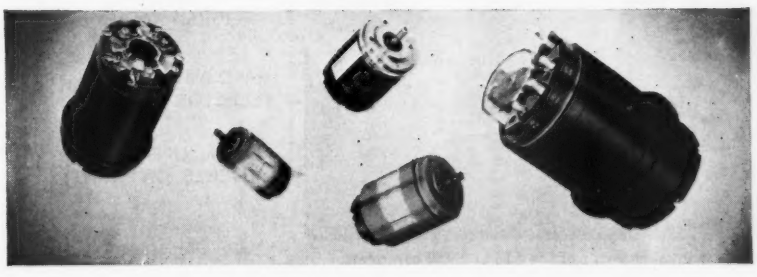
This timer incorporates a new motor, the Rodene Type 2000, which is also supplied separately for driving recorder charts, etc. It is a heavy-duty synchronous unit with the low rotor speed of 375 r.p.m. and a built-in gear box giving speeds down to 0.2 r.p.m.

The motor also has a built-in automatic clutch which frees the drive-shaft when the motor is disconnected from the mains. This feature facilitates hand-setting and simplifies the provision of automatic zero reset.

D. Robinson & Co., 9 Rectory Field, Harlow, Essex.

(Right) The new Rodene timer.

(Below) Precision Synchros to be manufactured by Ketay Limited.



Machines for the Industry

Two Process-Controlled Compression Presses

25 ton and 250 ton machines manufactured by Bradley and Turton Ltd.

THE model 536U/1 press has been designed to offer as wide a range of characteristics as possible. It is of the downstroking type, with an upstroking transfer/ejector cylinder, is fitted with an automatic process controller, and gives a closing ram approach speed of 6 in. per second. Of particular interest is its simplicity of operation, coupled with extreme flexibility of movement. It is this aspect of the machine that will be brought out in the following notes, which are related to the sectionalized drawing on the page opposite. As is standard practice in the " Machines for the Industry " series, the text matter is related to the drawing by numbers. Reference to the part under discussion can thus be easily made.

Method of Operating

The press may be operated by three methods:

(1) Hand control only, by direct operation of the control valves (1) and (2).
(2) Hand control, by operation of the control switches on the front of the control panel.
(3) Automatic operation by means of push button control.

Method 1

This is used for trying out the press, and tool setting operations. The panel door (shown open and cut-away in the drawing) must be open, and change-over switches on the inside of the door operated to the off position. To actuate the closing ram, use is made of the selector valve (1). The transfer/ejector ram is operated by valve (2).

Method 2

This is used for normal hand control of the press, and for short run production. The switches mentioned above are operated to the manual position, and the panel door is then closed. Use is then made of the switches on the front of the door. The first, when depressed, will close the press, and when in the up position, will open it. The second controls the transfer/ejector ram in a similar way.

Method 3

This is for fully automatic operation in normal production work. The change-over switches on the inside of the door are operated to the automatic position. Operation is fully automatic for the press cycle by pressing the button (3), which brings the automatic cycle controller into operation, the controller discs having been set to the required press cycle. The pneumatically operated guard is electrically interlocked with the controller and pressure on (3) causes the guard to close first, followed by the closing of the main ram. If the guard encounters any obstacle as it descends both it, and the ram, return to the press open position automatically. If for any reason such as misplaced inserts it is necessary to return the press to the top of the stroke, the reset button (not shown) will, if pressed, cause the press to return to the press-open position.

Press Adjustments

Closing Ram Pressure

This is adjustable by the relief and unloading valve (4) mounted on the supply tank.

Closing Ram Pressure Build-Up

The rate of build-up of the closing ram pressure is controlled by valve (5). With the adjusting screw fully upwards, the spindle is held off its seat, giving full flow and quick pressure build-up, and conversely, when fully downwards, a reduced rate of build-up.

Transfer/Ejector Ram Pressure

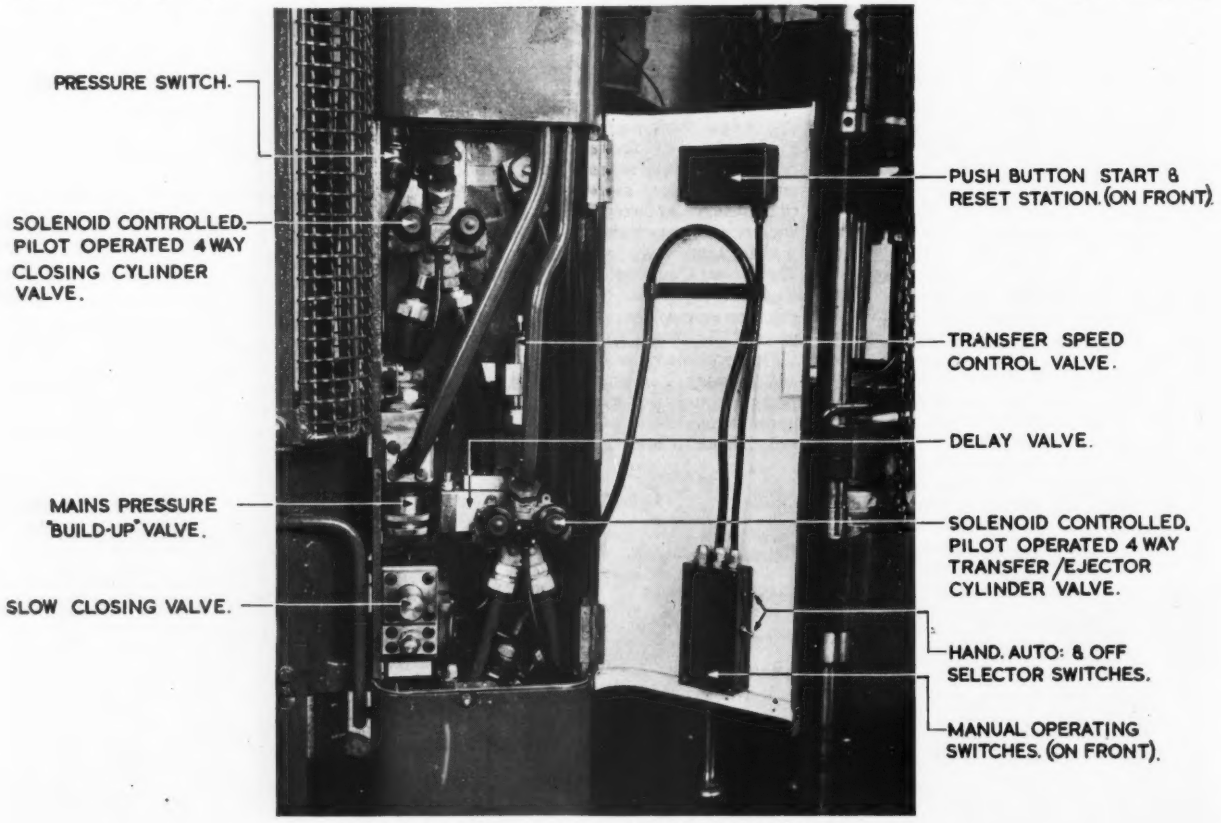
This is adjusted by a reducing valve (not shown).

Closing Ram Stroke

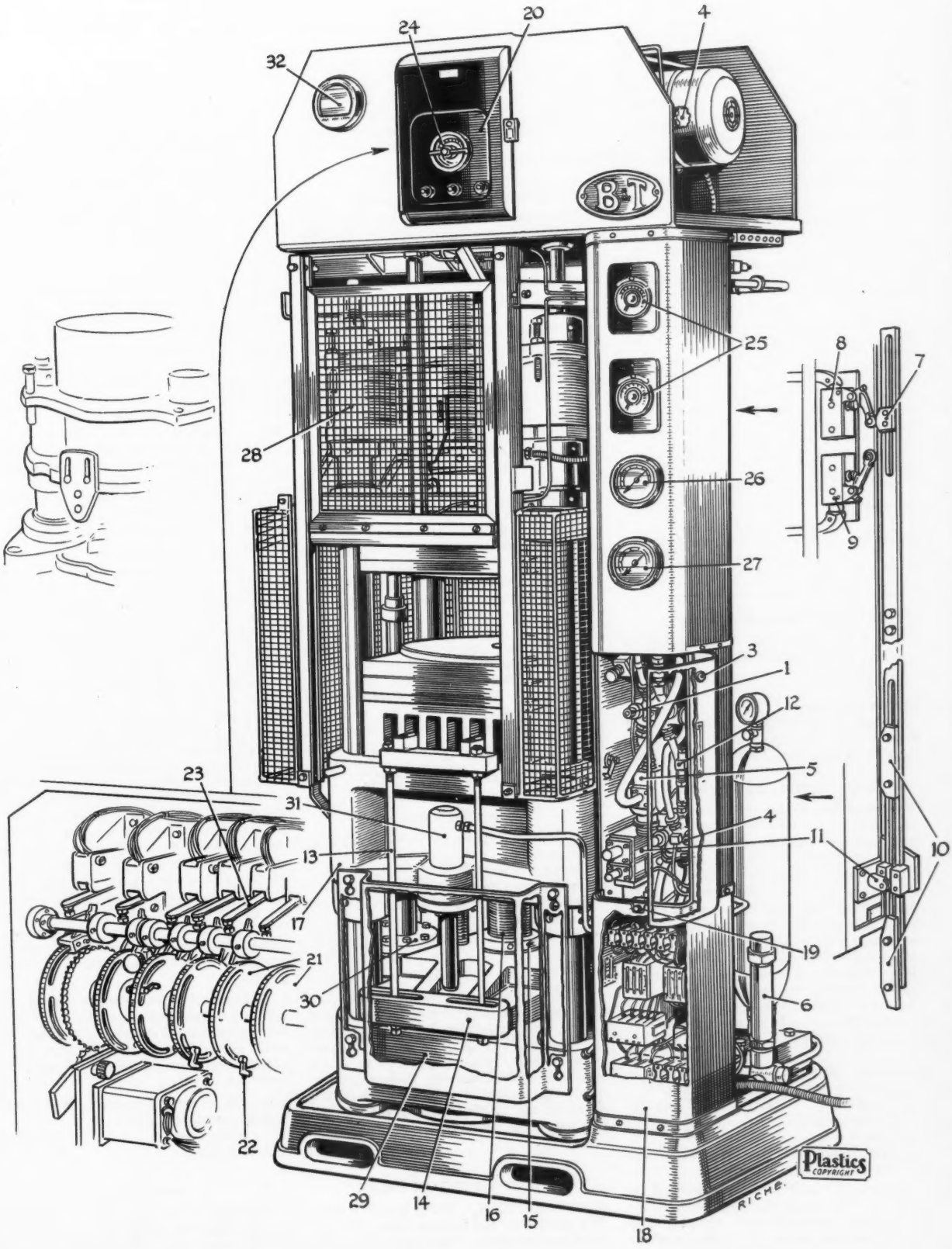
This is fully adjustable between a maximum of 15 in. and a minimum of 6 in., by means of the cam (7), operating switch (8). If for any reason the reset button is depressed, the automatic controller resets and the closing ram returns. In this case, however, the cam then operates the limit switch (9) which is used only in conjunction with the reset operation, and therefore the ram will stop its upward motion at this point, $2\frac{3}{8}$ in. before the normal stopping position. This is to allow the press to return without lifting the semi-automatic ejectors and pins.

Closing Ram Speed

As will be seen in the specification, the


PRESSURE SWITCH.
SOLENOID CONTROLLED, PILOT OPERATED 4 WAY CLOSING CYLINDER VALVE.
MAINS PRESSURE "BUILD-UP" VALVE.
SLOW CLOSING VALVE.
PUSH BUTTON START & RESET STATION. (ON FRONT).
TRANSFER SPEED CONTROL VALVE.
DELAY VALVE.
SOLENOID CONTROLLED, PILOT OPERATED 4 WAY TRANSFER/EJECTOR CYLINDER VALVE.
HAND. AUTO: & OFF SELECTOR SWITCHES.
MANUAL OPERATING SWITCHES. (ON FRONT).

Detailed view of the manual controls of the 536 U/1 250 ton press.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press has a fast approach and return speed, changing over to a slow speed for mould closing and opening, and again at the top of the stroke for ejection. The position of this speed change-over is readily set to suit varying tools and conditions by adjustment of the cams (10). These cams operate the spindle of the valve (11) and close or open the main sleeve ports, thus directing oil flow through the choke spindle. Adjustment of this choke spindle will vary the slow speed accordingly.

SPECIFICATION—PRESS AND PUMP

Working pressure	P.S.I.	3000 adj. to 500
Closing ram diameter ...	In.	12
Closing ram stroke... ...	In.	Max. 15 adj. to 6
Closing ram load	Tons	Max. 150, Min. 25
Push back rams (2) diameter	In.	$2\frac{1}{2}$
Push back rams load ...	Tons	Max. 13, Min. 2
Transfer/ejector ram diameter	In.	6
Transfer/ejector ram stroke	In.	Max. 6, adj.
Transfer/ejector ram load...	Tons	Max. 37, Min. 10
Transfer/ejector return rams (2) diameter ...	In.	$1\frac{3}{4}$
Transfer/ejector return rams load	Ton	6
Daylight (Total)	In.	30 adj. by stroke
Daylight with stand, elect. platens and grid... ...	In.	$17\frac{3}{4}$
Platen area standard ...	In.	20 x 20
Auto ejection stroke (semi-auto)	In.	$2\frac{3}{8}$

Pump capacity:
4150 cu. in./min. @ 400 p.s.i. 563 cu. in./min. @ 3000 p.s.i.
Motor particulars:
4 h.p. 1500 r.m.p. 380/420 v. 3 p.h. 50 cycles.

Transfer/Ejector Ram Stroke

This stroke is variable according to the moulding cycle and method of transfer ejector employed.

Transfer Ram Speed

This speed is variable by means of adjustment of valve (12). Clockwise rotation decreases and anti-clockwise rotation increases the speed.

Ejection Methods and Adjustments

Semi-Automatic Ejection

Effected (*a*) by pins resting on extractor beams or (*b*) by outside rods (13) attached to ejector table (14). With this method the extractor beam is lifted by the extractor rods when picked up by the closing ramhead on the return stroke. The beam in turn picks up the ejector table by means of ejector rods. Ejector rod adjusting nuts must be screwed downwards and locked against the ejector table (14) and the tool holder adjusting ring (15) must be screwed upwards to clear stroke of ejector table when this lifts. The ejection stroke is adjustable from 0 to $2\frac{3}{8}$ in. by means of nuts in the extractor rods.

Independent Ejection

(*a*) Ejection from central tool holder (16).
(*b*) Ejection from ejector table (14) by outside rods (13).
(*c*) Ejection from extractor beams.
(*d*) Two-stage ejection with central tool holder and extractor beam.

Ejection on return must be controlled by valve (2). When using the central tool holder for ejection, the ejector rod adjusting nuts must be screwed against the underside of the press table (17) and locked. Stroke adjustment is from 0 to 6 in.

Electrical Section

The electrical gear is housed in the lower section of the control panel and is accessible only after the door is unlocked and opened, when the lower panel (18) may be removed.

On the inside of the door is the push button station for automatic control, and the connecting box containing the change-over switches and manual operation control switches. On the top of the lower section of the panel is an isolating switch (19) which is actuated by the door when closed.

Automatic Time Cycle Controller

This controller (20), which can be set to automatically control the complete moulding cycle, has a rotating camshaft timed for 20 seconds rotation. Attached to the discs (21) of this camshaft is a series of operating dogs (22) which select a line of micro-switches (23) in the top of the instrument, which in turn select the appropriate section in the electrical system for the press cycle. The dogs on the left-hand side of the discs operate the micro-switches, and those on the right-hand side de-operate them. The controller is fitted with a process timer (24) for individually setting the cure period time.

It is also equipped with a reset mechanism which automatically returns the camshaft to zero when the reset button is depressed. The movements of the cam discs are all based on time, and each disc is divided into 100 parts, each division therefore representing one-fifth of a second. With the master disc set at zero, it follows that all the other discs must be set according to time from this master disc, and not from the preceding ones.

General

Mounted on the main control panel are top and bottom platen temperature regulators (25). Immediately beneath them are the closing cylinder gauge (26) and the transfer/ejector pressure cylinder gauge (27). The remaining main items of the press are: closing cylinder (28), transfer/ejector cylinder (29), closing return cylinders (30), transfer/ejector return cylinders (31), and oil level sight (32).

Operating Speeds

The following figures are based on accumulator operation.

Closing ram approach	6 in. per sec.
Closing ram return	5 in. per sec.
Transfer/ejector ram approach	up to 4 in. per sec.
Transfer/ejector ram return	2 in. per sec.

Conclusion

From the foregoing it will be evident that the design of the 536 U/1 press has been based on the latest techniques for automatic time cycle control, and linked with the materials available today where rapid closing speeds may be desirable or essential. Both the requirements of modern thermosetting moulding technique are satisfied—precise control over the moulding sequence, and high speed operation.

THE 50W/1 25-TON PRESS

THE model 501W/1 25-ton hydraulic press is notable for five features which will commend it to moulders. These are (1) Simplicity of operation and setting, (2) Soundness of construction, (3) Versatility, (4) Fast cycling, (5) Automatic control. The press illustrated is designed for operation from an accumulator system but it can readily be converted into a self-contained unit operating from a direct pumping system.

Constructional Details

The 501W/1 is an upstroking press with a main ram diameter of 6 in., a stroke of 12 in. and a main ram load of 28 tons. The two push-back rams have a diameter of $1\frac{1}{2}$ in. giving a load of 3.5 tons. The platen area is $12\frac{3}{8}$ in. × 12 in. and the press has a maximum daylight of 18 in., the top platen being adjustable through 6 in. by means of a screw thread on the four press columns. The overall height of the press is 6 ft. 3 in.

When operated from an accumulator system the oil passes through the check valve and filter before entering the control circuit of the press. The main control valve (34) has both manually operated buttons for use for "inching" in tool setting and an electric start and reset push button control (35). The press can also be operated by closing the guard. A feature of the operation of the press is its fast approach speed, but it also has a slow speed for mould closing and opening and also a slow speed at the bottom of the stroke giving slow ejection. The position of the platen where this speed change-over takes place can be easily adjusted by moving the cams (36 and 37) which operate the speed control valve (38).

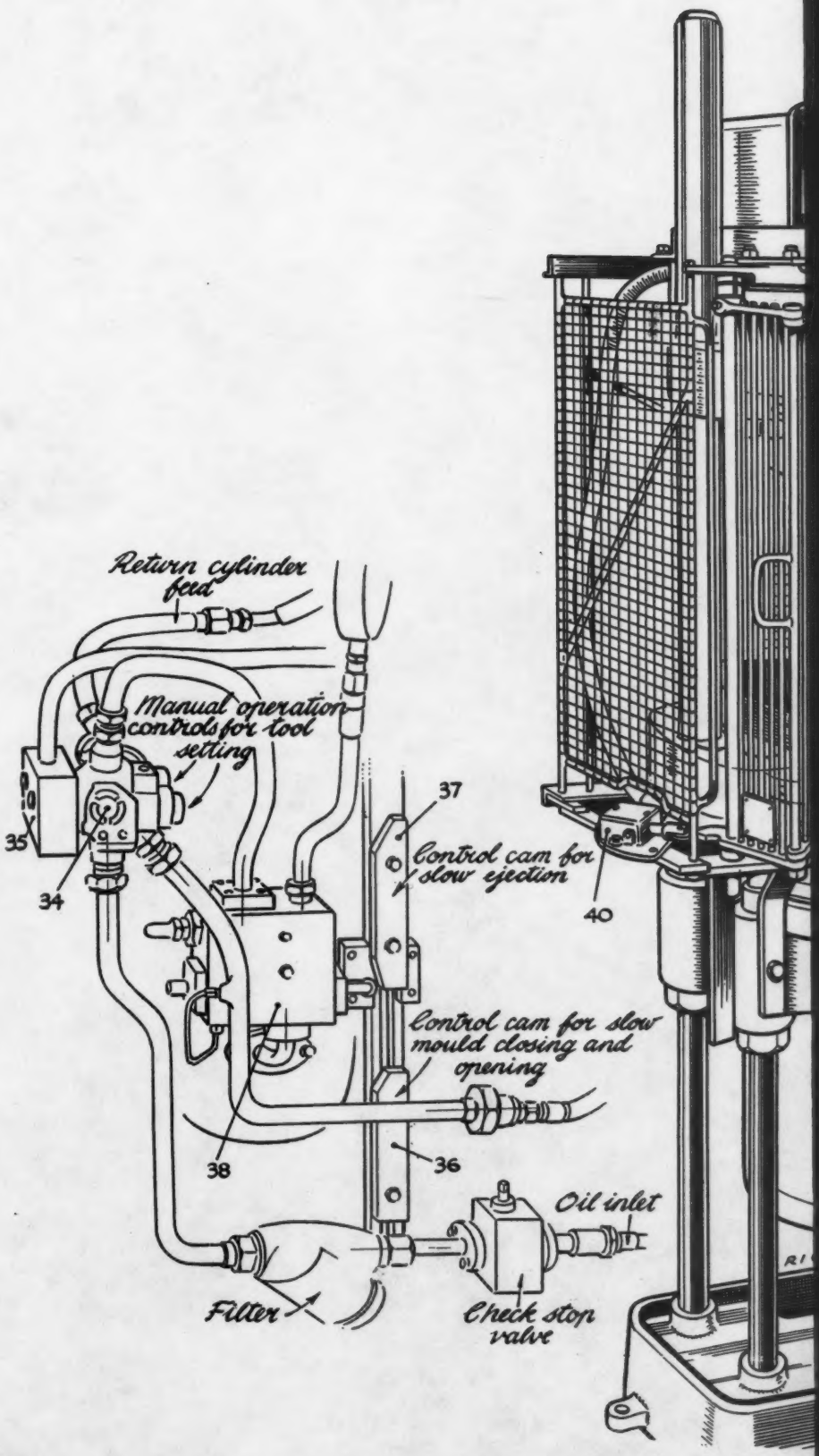
For both convenience and economy it is often advisable to operate a press on as near a completely automatic cycle as is possible. The 501W/1 is especially suited for this type of work. The complete cycle of operations can be initiated by closing the press guard, which operates a control switch (40) and thereby closes the press to the pre-determined initial pressure, when the pressure switch in the Burrel process timer (33) starts the cycle of operations. A description of this timer was given on page 231 of the September issue of *Plastics*, but it is worth repeating some of its main features. Principal of these is the simplicity with which it can be set to perform a number of operations. For example, on this press after the initial closing pressure it determines the length of the close and dwell period, initiates the breathe period should one be required and finally controls the cure period prior to the opening of the press and ejection of the finished moulding. Having completed the cycle, the timer automatically resets in preparation for a second cycle of operations. The press is also fitted with two temperature regulators (39) and a pressure gauge.

As mentioned previously this press is a fast cycling press suitable for moulding fast curing alkyd materials and an indication of the speeds of the main ram based on the hydraulic supply coming from an accumulator system will verify this claim.

Closing ram approach speed	6 in. per sec.
Slow mould closing and opening speed	adjustable
Return speed	3 in. per sec.

Acknowledgment

The writers, who have had the opportunity of operating both of the foregoing presses on several occasions, acknowledge the help afforded by Bradley & Turton, Ltd., in the preparation of these reports.


Return cylinder feed
Manual operation controls for tool setting
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Control cam for slow ejection
40
Control cam for slow mould closing and opening
38
36
Oil inlet
Filter
Check stop valve
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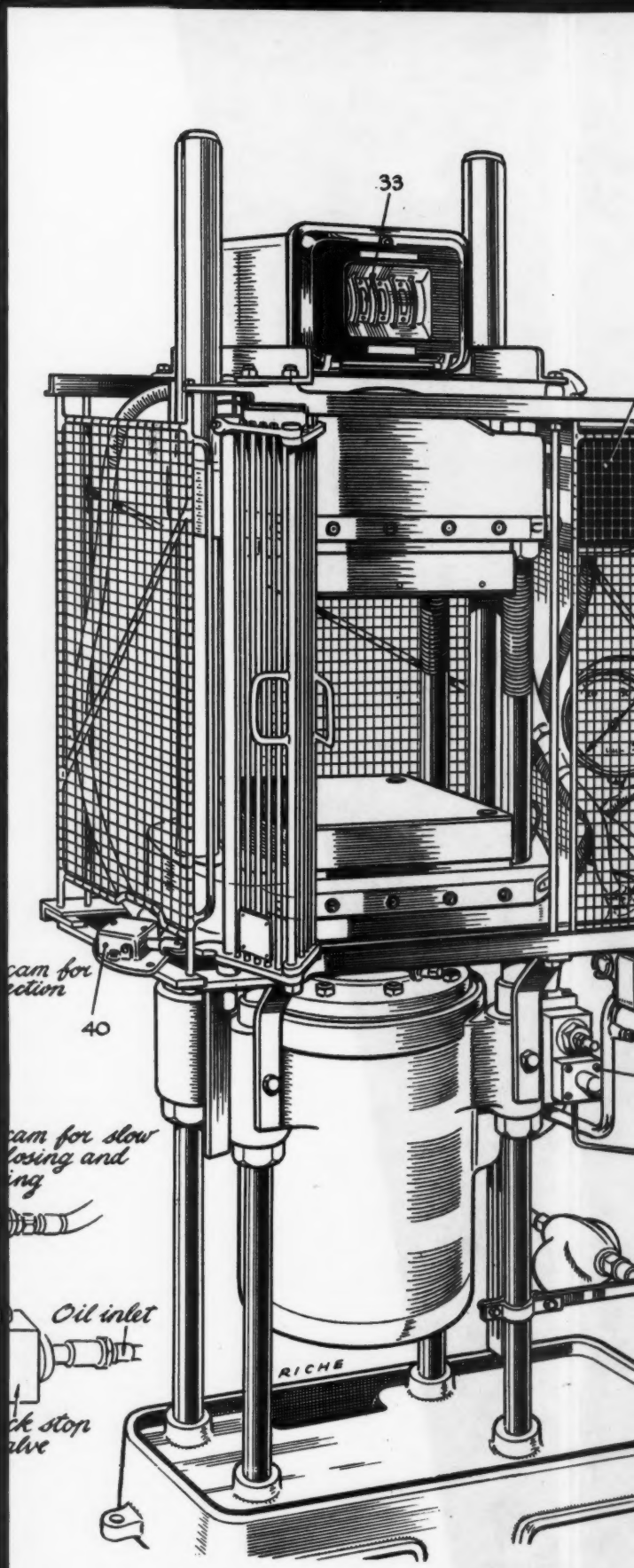

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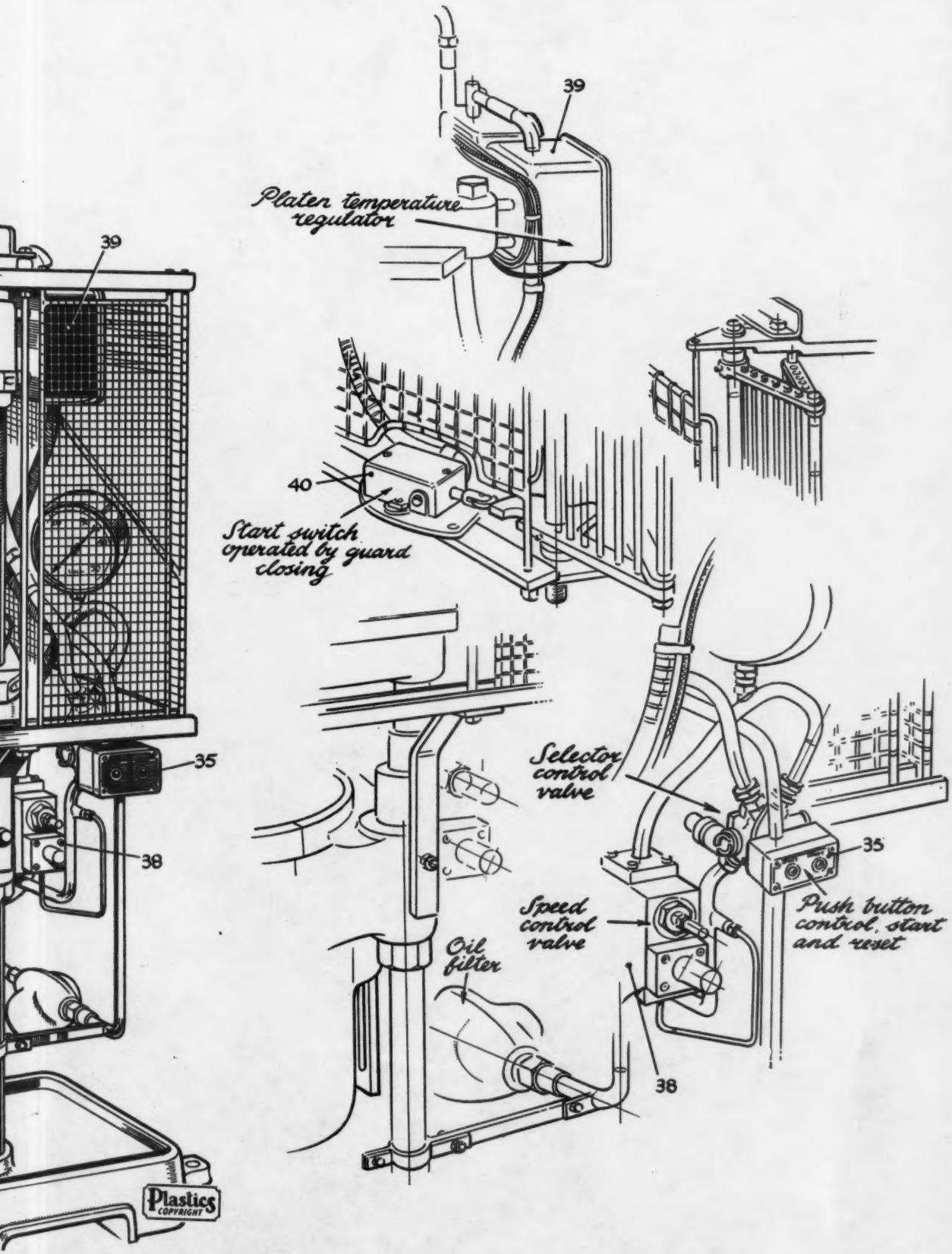


TD., 25 TON UPSTROKING PRESS

Polishing Plates for Sheet Plastics Materials

READERS of *Plastics*, familiar with the manufacturing process of cellulose acetate, cellulose nitrate sheet and rigid vinyl sheet will recall that one of the critical operations is the polishing of the sheet to give the high gloss finish that is essential in so many applications. For example, a common method of making cellulosic sheet is to slice from a rectangular block of material mounted on a reciprocating table against a knife edge. However sharp the blade, and they are very sharp indeed, knife marks in the form of surface scratches are inevitable. The removal of these is effected by pressing each sheet of acetate at a temperature of 60–70°C between highly polished nickel-plated plates—temperatures for nitrate are somewhat lower. It follows, therefore, that the surface of the plates must be of mirror quality, entirely free from blemish, surface irregularity etc.

Fig. 1. Central view of newly constructed plating shops.

At the Brantham works of B.X. Plastics Ltd., we recently had the opportunity of viewing the new plating shops, installed to cater for the demands of the sheeting section of the company, in which many hundreds of these plates in different sizes are in use. A general view of the newly constructed shops is shown in Fig. 1.

The base sheet, measuring from 4 ft. 6 in. × 2 ft. to 8 ft. × 5 ft., is rolled brass, imported from Germany since sheets of these dimensions and the desired quality are not made in Britain. An extremely high standard is set for the base stock, since it must itself be perfectly smooth. Accidental damage such as a hammer blow when crating the sheet, would cause its rejection, since the indentation would be present despite any plating that might be carried out.

On delivery to Brantham, the plates are then processed for use in the sheet making division.

The first stage is thoroughly to clean the brass plates. This is essential if good adhesion of the nickel to the brass is to be obtained. Alkaline solutions are used, and the plates are then dipped in a weak cyanide solution followed by a dilute hydrochloric or sulphuric acid dip to remove tarnish.

The Watts bath is the mainstay of modern nickel plating processes, and consists fundamentally of a solution of nickel sulphate containing some chloride and boric acid. The operating conditions are 90–95°F, a current density of 20–40 amps./sq. ft. and pH of 5·6–5·8. In Fig. 2 an operator is seen inspecting a plate on emergence from the bath. Special care is taken, in view of the importance of the high quality finish required, to maintain optimum conditions during plating.

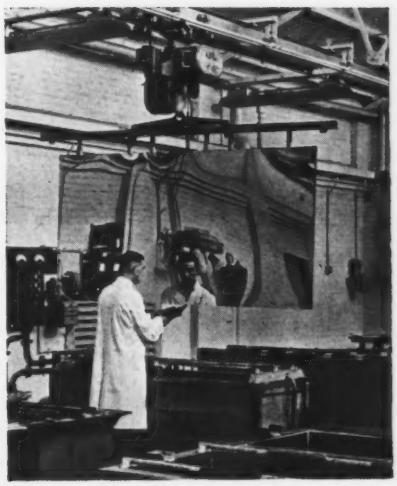


Fig. 2. Plate inspection.

The final process involves the polishing of the plates to mirror finish by means of buffing machines; the example shown in Fig. 3 is the new large machine recently installed at Brantham to polish plates measuring 8 ft. by 5 ft. Clamped on a reciprocating table, the plates move backwards and forwards under a rotating buffing cylinder. Operators in charge of these machines achieve a beautiful finish to the sheet, as may be judged from Fig. 4, where a polished sheet is shown being lifted clear of the machine.

The plating department also services the polishing plates as they become worn from constant use. At first repolishing will suffice to renew the surface, but eventually replating is necessary.

BX Plastics Ltd., claim that the 8 ft. by 5 ft. plates now in use are the largest of their type produced in Britain and probably in Europe, necessitating considerable pioneer work on the equipment used to obtain the required standard.

Fig. 3. Buffing machine for plates 8 ft. by 5 ft.

Fig. 4. An example of the finish obtained.

Polyester Laminating Resins—Part 1

By J. BRYDSON, A.I.R.I., A.N.C.R.T.,* and C. W. WELCH†

This article examines the formation of polyester resins, cross-linking and catalysis, and is based on an investigation programme carried out with the object of studying some of the lesser known aspects of this branch of high polymer chemistry. A theoretical mechanism for the cross-linking reaction is proposed.

Introduction

FROM time to time observations on polyester resins have appeared in the technical journals, mainly of a general nature. A review of the published literature, however, will show that the criticisms levelled at polyester resins may be classified into some seven broad groups. For the fully successful exploitation of these resins, it would seem that answers to these criticisms will have to be found, and research to this end will embrace chemical, physical and technological problems.

These criticisms may perhaps be more correctly termed "Aspects for Study," and are listed below. The authors have studied two of these aspects, and it is with this work that this paper is mainly concerned. For many of the original ideas on which the paper is based, the authors have to thank Mr. M. D. Curwen, Editor of *Plastics*, who also gave much time in advising during the investigation programme.

Aspects for Study

1. Inflammability of the resin.
2. Physical properties at elevated temperatures. These appear to be poor at the moment.
3. Investigation of the cross-linking reaction. Little work appears to have been reported.
4. Methods of testing. Development work is hindered by lack of standard methods of testing resins, glass, and products.
5. Ageing properties. Little reliable data is available on this aspect, and long-term ageing must be regarded as an unknown quantity.
6. Resin modulus. Premature cracking of the resin well below the tensile strength of the laminate is often observed, due to the incompatibility of the modulus of the resin with the rate of fibre strain.
7. Manufacturing methods. The conversion from pilot plant stage to production of a product often destroys the initial advantages of these materials.

Points 1 and 2 are gradually being overcome. For example, chlorendic acid is now being used as one of the condensing acids to improve flame resistance. It is, however, considered that ageing properties are inferior. Other work reported discusses the use of fillers (1).

Elevated temperature resistance is being improved by using cross-linking agents other than styrene. Tri-allyl cyanurate has been claimed to be good in this respect but the actual properties when measured at elevated temperatures seem to be little better than that obtained from the more conventional resins.

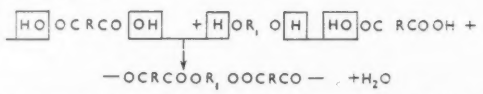
Modulus of the resin can be controlled by varying the ratio of rigid to flexible resin and in this way premature breakdown may be avoided.

As already noted, however, the work to be described here concerns investigation of the cross-linking reaction and methods of testing. Certain results are inconclusive, but it is hoped that the lines of approach indicated will stimulate further work elsewhere, both on the specific points discussed here and the general subject listed above.

The Formation of Polyester Resins

Before dealing with the above items it is worth reviewing the well-known formation of polyester resins.

These are formed by the reaction between dibasic acids and dihydric alcohols.



In the case of the laminating resin a proportion of the acid is of the unsaturated type such as fumaric acid. This means that there are points on the polyester chains which are open to a double bond type polymerization.

A typical resin formulation would then be:—

Propylene glycol	..	1 moles
Fumaric acid	..	0·67 moles
Phthalic anhydride	..	0·33 moles

Diethylene glycol and propylene glycol are the normal di-alcohols used, the ester formed from ethylene glycol being only sparingly soluble in styrene.

Of the unsaturated acids fumaric acid and maleic acid are commonly used, fumaric acid giving a slightly better heat distortion point.

Phthalic anhydride and adipic acid are used for the saturated acids.

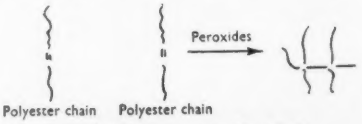
Although the point will be developed later, reference should be made here to the possible effect of using a high ratio of unsaturated acids, which may well serve to weaken the resin in the finally cured phase. A limited comparison is possible here with the phenol/formaldehyde reaction where the actual degree of cross-linking (estimated at 3% of the theoretical value), is due to the rise in viscosity, water occlusion, etc. In a polyester where the unsaturated acid content is high, only a proportion of the double bond linkages will be satisfied, for similar reasons. It has been shown, as an extension to the work of Flory, that at the gel point, only one double bond need be reacted per two polymer chains. Residual unreacted double bonds may cause shrinkage of the resin mass away from the glass, and may in other ways weaken the mass structure by further polymerization after gelation.

The reaction is carried out in a resin kettle at a temperature between 110–200° C. Water is removed as soon as it is formed and the reaction is continued until the acid value is approximately 30–40. The resin is then partly cooled and blended with the styrene, inhibitors and anti-gelation agents.

The reaction may take from 8 up to 30 hours depending on the temperature, acids and alcohols used on the unsaturated/saturated acid ratio. An increase in unsaturated acid increases the rate of condensation, generally increases the reactivity of the resin and reduces the flexibility of the final cross-linked product.

The Cross-Linking Reaction

The double bonds which are residual in the polyester are capable of "opening-up" and cross-linking under certain conditions. The cross-links may be between two adjacent polymers or may be styrene, methyl methacrylate triallyl cyanurate or di-allyl phthalate bridges.



Cross-link between double bonds.

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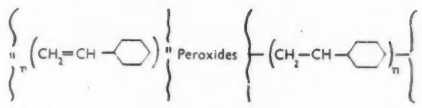
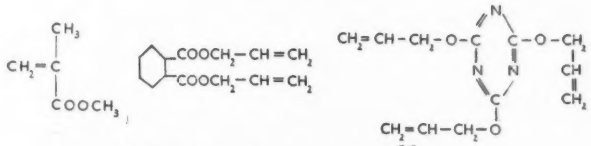
† Assistant Editor, *Plastics*, Visiting Lecturer, National College of Rubber Technology.



Styrene bridge.



(L to R) Methyl methacrylate, di-allyl phthalate, tri-allyl cyanurate.

Normally there is a definite need for a cross-linking agent such as styrene. Polyester resins are rather viscous for direct application and a reactive diluent of the styrene type may be used to control the viscosity as desired.

Methyl methacrylate is often used where improved light permeability is required and tri-allyl cyanurate is claimed to impart better heat resistance than styrene. Vinyl toluene because of its reduced volativity is now sometimes used in the U.S.A.

There are two ways of setting the resins:—

(1) Hot curing with benzoyl peroxide.

Here the reaction mixture catalyzed with benzoyl peroxide will harden in as little time as a minute.

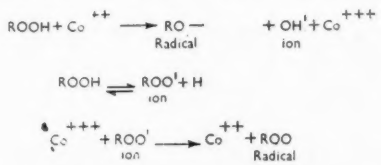
(2) Cold curing with a peroxide catalyst and a metallic naphthenate accelerator.

In this case benzoyl peroxide is unsatisfactory and cyclohexanone peroxide and methyl ethyl ketone peroxide are frequently used. The only naphthenate known to be used commercially is cobalt naphthenate.

It is with this latter type of setting that this paper is mainly concerned. So far as the literature has been studied, no attempt has yet been made to propose a mechanism for the reaction, and what follows is an endeavour by one of the authors (J. Brydson) to produce a scheme which is in accord with research in other fields including the paint industry.

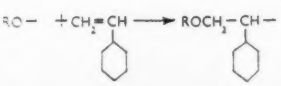
The system appears to fit the known facts and is also in accord with current theories on addition polymerization and modern drying oil chemistry.

Initially the cobalt reacts with the peroxide as follows:—

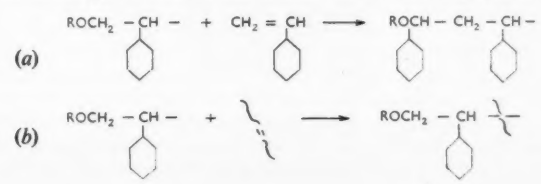


The cobalt is therefore regenerated to its original state. This reaction therefore produces free radicals which initiate the polymerization cross-linking.

E.g.

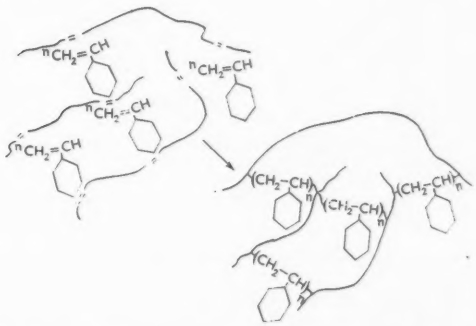


The styrene radical may then attack either another styrene molecule (*a*) or one of the double bonds in the polyester (*b*).



These propagation reactions are of the type occurring in free radical copolymerization and will continue until terminated by collision either with another free radical or an inhibitor molecule such as quinone.

In this reaction each polyester chain will be involved at least once and infinite networks will build up in a way indicated below.



The integer *n* may take any number over a whole range of values. This type of polymerization may be compared with the Friedel–Crafts ionic polymerization, noted by L. Wood and others in relation to butadiene, etc. (2), (3), (4), (5).

The above scheme should be satisfactory from the theoretical viewpoint. It was, however, considered that the reaction should also be studied from the technologist's point of view and therefore the following variables were investigated:—

(1) Effect of varying catalyst and accelerator.
(2) Effect of temperature.
(3) Effect of different metallic naphthenates.
(4) Effect of varying styrene content.

1. Effect of Varying Catalyst and Accelerator

In this experiment the effect of varying quantities of catalyst and accelerator on the gelling time was noted. Gelation was observed visually. The resin used was Bakelite S.R.17440, the accelerator cobalt naphthenate (containing 6% metal) in a solution in styrene and the catalyst a 60% solution of methyl ethyl ketone peroxide in dimethyl phthalate.

The following results were observed at 25° C.:—

TABLE I

Catalyst (mls.) per 50 gm. resin	Accelerator (mls.) per 50 gm. resin	Gel Time (T) (mins.)	Rate $\frac{1}{T}$
3	3	8	·125
3	2	9	·110
3	1	12	·080
3	0·5	17	·060
2	3	9	·110
2	2	12	·080
2	1	23	·040
2	0·5	44	·020
1	3	10	·10
1	2	12	·08
1	1	42	·02
1	0·5	103	·009
0·5	3	66	·015
0·5	2	74	·013
0·5	1	145	·006

Fig. 1 shows the variation of setting time with varying accelerator keeping the catalyst constant.

Fig. 2 shows the variation of setting time with varying catalyst keeping the accelerator constant.

Fig. 3 shows the effect of plotting the product of catalyst and accelerator against the reciprocal of time.

This, although indicating that it is the product of catalyst and accelerator that is the governing factor, also shows the effect

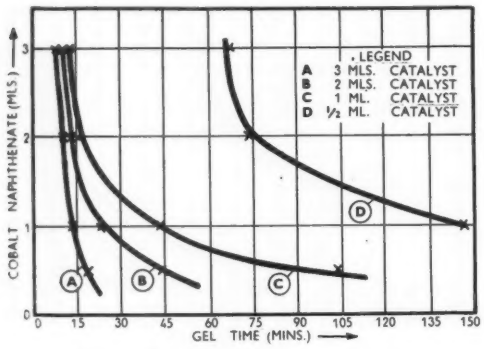


Fig. 1. Effect of accelerator on gel time.

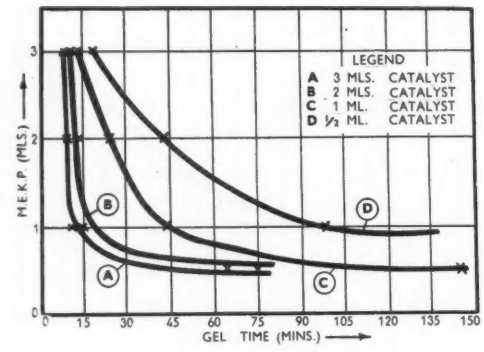


Fig. 2. Effect of peroxide catalyst on gel time.

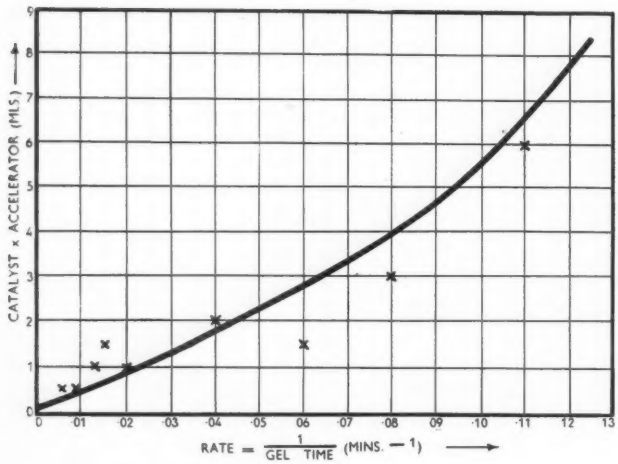


Fig. 3 (Above). Effect of plotting the product of catalyst and accelerator against the reciprocal of time.

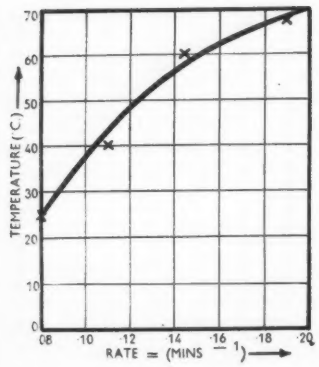


Fig. 4 (Left). Effect of temperature on gel rate.

previously noticed by the authors that the rate does not increase uniformly. In fact with large amounts of catalyst and accelerator the rate actually decreases.

2. Effect of Varying Temperatures

This was found to affect the setting time exponentially. The following mix was used:—

Bakelite S.R.17440	50 gms.
M.E.K.P.	2 mls.
Cobalt accelerator	2 mls.

TABLE 2

Temp. (° C.)	Gel Time (mins.)	Rate $\frac{1}{T}$
25	12	·08
40	9	·11
60	7	·143
68	5	·200

Fig. 4 shows the effect of plotting the temperature against the rate.

3. Effect of Type of Naphthenate

This experiment was initially carried out to find whether it was possible to replace cobalt naphthenate with any other types. A summary of results is shown in Table 3, from which it will be seen that with the exception of vanadium naphthenate, no other naphthenate examined could offer a gel time comparable to cobalt, on the basis of the metal content employed. However, as noted below, further work is required to establish on a quantitative basis the comparable effectiveness of various naphthenates.

It is interesting to note that whilst a considerable quantity of data exists on the efficiency as initiators of many types of peroxides (6) little or no investigation appears to have been made into the naphthenates.

TABLE 3. PUNCH SHEAR (P.S.I.) AGED AT 70° C.

Naphthenate (Metal Content)	Gel Time (mins.)	Initial	7 Days	35 Days	63 Days
6% Cobalt ...	12	13,700	15,200	13,800	12,200
1% Manganese	78	13,100	14,100	13,700	14,700
,, Calcium ...	366	10,100	17,200	15,200	12,800
,, Zirconium	433	—	—	—	—
,, Cerium ...	896	—	—	—	—
,, Nickel ...	> 1,000	12,900	15,800	14,500	15,400
,, Lead ...	> 1,000	—	—	—	—
,, Chromium	> 1,000	—	—	—	—
,, Tin ...	Incomplete after 24 hrs.	9,700	15,600	16,300	16,100
,, Vanadium	1	—	—	—	—

In this experiment two layers of 2 oz. Fibreglass needle mat (" Format ") were impregnated with the following mix:—

Polyester resin	50 gms.
M.E.K.P.	2 mls.
Naphthenate	2 mls.

They were cured at room temperature at contact pressure. Punch shear measurements were carried out in the Hounsfield Tensometer. Ageing was carried out in an air-circulating oven at 70° C. Fig. 5 shows an interesting comparison, related to Table 3, on strength characteristics for cobalt, calcium, nickel and tin naphthenate.

Throughout it will be noted that, following the usual method an equal volume of metallic naphthenates has been employed, an important difference being that in the case of cobalt naphthenate the solution contains 6% metal while all others contain only 1% of the indicated metal. This great difference has been deliberately made to show that very small quantities have their effect. Since throughout, 2 millilitres of the naphthenate solutions have been used, we note that this means that in 50 grams of resin 0.12 grams

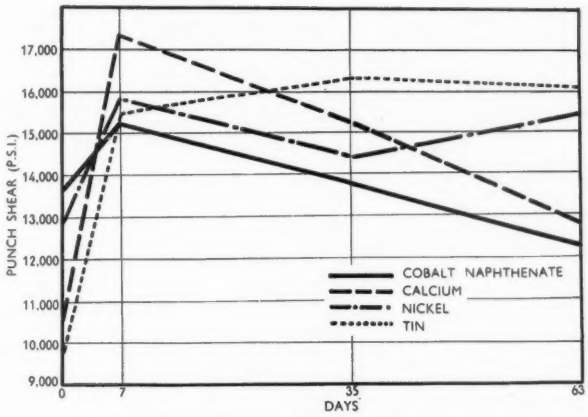


Fig. 5. Punch shear strengths plotted against time. See data given in Table 3.

of cobalt metal are present whereas in all other cases only 0.02 *grams of metal has been used.*

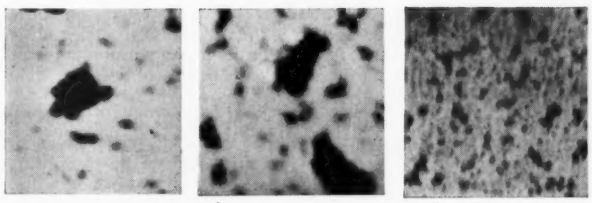
The normal method of employing volumes and basing calculations on metallic naphthenate content has been followed here. In future it is to be hoped that all calculations will be based on weight and only on the percentage weight of the metal employed.

From these results, although rather variable, the following points are of interest.

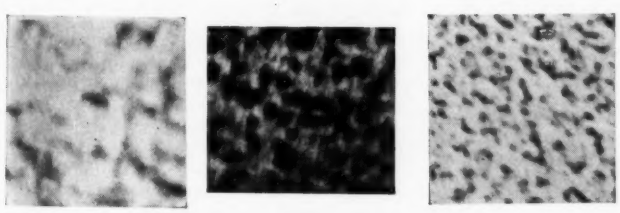
(1) The instantaneous setting occurring with vanadium compounds which are often powerful reducing agents; this effect strengthens the belief that in the analogous reaction with cobalt, the function of the accelerator is as a reducing agent. Colour changes on mixing the vanadium into the catalyzed polyester resin are in accord with this reducing action.

Although a vanadium accelerated mix is difficult to handle the possibility of some type of twin-nozzle injection moulding machine for cold curing of polyesters is certainly a possibility.

(2) The more rapid the setting the greater the initial strength but the lower the final strength after ageing. In order to substantiate this observation correlation tests were applied which found these results to be significant.



Figs. 6, 7 and 8. Fused lead naphthenate in white spirit. Magnification x 28,000. Dil. 1:1, 1:2, 1:4. The width of each photo equals one thousandth of a millimetre.



Figs. 9, 10 and 11. Precipitated lead naphthenate in white spirit. Magnification and dilutions as above. Again the width of each photo equals one micron.

As a corollary to this it is seen that:—

(*a*) Setting time is proportional to the optimum post-curing time, i.e. the faster the setting the more rapidly the maximum strength is reached.

(*b*) In each case there is a peak in strength in the strength-time curve.

It is believed that these results indicate that the cause of ageing in polyesters is not oxidation as has been suggested, but prolonged cross-linking which causes internal strain and hence premature breakdown on stressing. It is therefore difficult to see how the ageing of cold-setting polyesters may be improved. Prolonged cross-linking may be partly responsible for loss in strength of polyester/glass pipes measured over periods of up to 1,000 days. Pipe investigation has been carried out by F. R. Barnet and C. L. Lloyd (7) amongst others.

It is, however, suggested that the figures in Table 3 offer the basis of further investigation, to discover whether any mixtures of various metallic accelerators, improved strength and ageing figures can be obtained, even if cure at elevated temperatures is required. So far, no complete evaluation has been attempted to show the reactivity changes at various temperatures of each of the metallic accelerators studied, but there is evidence that acceleration efficiency may itself change at varying temperatures, not necessarily in proportion to the general gel time of the polyester itself. Analogous to this is the use of two or more organic peroxides which have their maximum catalytic efficiencies at different temperatures (8).

In an endeavour to investigate the initiator efficiency of the naphthenates discussed above, an electron microscope was employed, some results of which are shown below.

Dispersions of various naphthenates were made both in white spirit and chloroform, at varying dilutions, photographs being taken at magnifications of up to 28,000. By means of progressive dilution it was hoped to study the dispersion of the naphthenate into a solvent, and to relate this to the reactivity of the naphthenate. Furthermore, it was required to study the difference in dispersion, if any, between naphthenates produced by the fused and precipitated process.

Figs. 6, 7 and 8 show fused lead naphthenate, in dilutions of 1 : 1, 1 : 2 and 1 : 4. These show a progressive agglomeration in the solvent phase.

Figs. 9, 10 and 11 show precipitated lead naphthenate, in similar dilutions as above. The tendency here is for the fine dispersion to be maintained.

No attempt has yet been made to relate this aspect of the investigation to the initiator efficiency figures quoted in Table 3. It may, however, be argued that intensive dispersions of small particle size will offer greater possibilities for efficient initiation, than large agglomerations with correspondingly smaller total exposed surfaces. It is proposed to study this aspect in greater detail, in the hope that the considerable differences shown between one naphthenate and another (10 were examined by the technique described above) in so far as size of particle in solution is concerned, may help to explain one of the factors involved in the achievement of peak strength in a polyester structure, followed by a diminution of strength.

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(N.B.—The second part of this article, to be published next month, will deal with the effect of varying the styrene content, and methods of evaluating polyester resins and laminates.)

The Properties and Testing of Plastics Materials—Part 7

Sections 1 and 2—Identification and Analysis of Materials

By A. E. LEVER,* A.I.R.I., and J. RHYS,† M.Sc.

Section 1. Identification

MOST text books contain schemes for the identification and analysis of plastic materials but, in general, these schemes are not completely satisfactory because:—

(*a*) The methods given are usually limited to only a few plastic materials.
(*b*) They are too unweildly for routine use.
(*c*) Mixtures of plastic materials, and newer plastics, give misleading indications when considered in the light of these schemes.
(*d*) Complex compounding ingredients can also cause misleading results.

There is a short general scheme for identification (1) with detailed tables of properties of various plastic materials.

Plastic materials are divided into resins or polymers, compounded mouldings, solutions, varnishes, etc., and a scheme on this basis is presented (2).

The second edition of (3) has omitted its earlier scheme in favour of one based on the work of Shaw (4). The latter is very complete and is based on first removing compounding ingredients by appropriate means such as solvent/non-solvent procedure, extraction, etc. This is followed by identification of the elements nitrogen, sulphur, hydrogen and determination of the saponification value and acetyl number. From this information the material can be tentatively placed in one of several groups that are given, and the polymer identified by working through the appropriate table. This involves determination of solubility in specific solvents, behaviour on ignition, certain physical properties and specific chemical tests.

General schemes have also been given in (5), (6), (7), (8), and identification by solution in one solvent followed by precipitation by a non-solvent in (9), (10). Pyrolysis with condensation of the vapours in a cold test tube provides another method of identification (11).

There is a very complete work (12) dealing with raw materials polymers, plasticizers and fillers, and there is a good scheme of analysis for a wide range of plastics (13).

A scheme of identification based on simple tests is given (14). The tests include visual inspection, burning tests, general solubility, pyrolysis and colour reactions. This scheme appears to be based on (5).

It is often possible to combine chemical methods and physical properties with spectroscopy. X-ray examination and other physical-chemical techniques for purposes of identification.

There is a general review of advances in technique during the last five years (15).

Gas phase partition chromotography is used in (16). Pyrolysis, followed by infra-red spectroscopy is the basis of another method (17). It is reported that urea plastics were the only ones which failed to give a characteristic infra-red spectrum. The spectra of a number of plastics, fibres and rubbers are given (18), (19).

A very complete summary of the absorption characteristics of a number of elastomers is given (20). Limitations of the technique are discussed. Polymer spectra are not greatly affected by molecular weight (21), or by cross-linking (22).

There is a useful scheme for identification and analysis of natural rubber and synthetic elastomer compounds in (23). The chemical analysis of vulcanized rubber is covered by (24), and raw rubber and unvulcanized compounds by (25).

The identification of synthetic fibres is very well covered in (26), (27) which gives information on about 40 natural and 30 artificial fibres. Methods of tests for textiles issued by the British Standards Institution should be consulted (125).

A summary of physical properties and behaviour towards selected chemicals of polyvinyl chloride, mixed polymers, polyacrylonitrile, polyamines, polyurethanes and polyesters, will be found in (28). The use of Texchrome as an identification dye is discussed (29). This article also deals with flame tests.

The literature of the surface coating industry is also valuable, and various analytical methods for investigating different types of coating, whether soluable or insoluable, is given (30). There are 105 references.

The Libermann-Storch and Morawsky tests are investigated (31) and caution is advised in interpreting results with resins.

A series of articles on the microscopic examination of plastic materials is given (32).

Fluorescence tests under ultra-violet light are described (33), (34). The method is of doubtful value since impurities, plasticizers, fillers, etc., may give a fluorescence that alters the nature of the polymer.

Section 2. Special Tests

Polyethylene

IT has been shown (35) that in the infra-red spectrum there is a doublet at 725 cm^{-1} which becomes a single band on melting. Unsaturation in the molecule is discussed (36).

Polytetrafluorethylene

The problem with this material is to find a satisfactory method of quantitatively determining the amount of fluorine present. Methods for attacking this problem are given (37), (38), (39).

Polystyrene

The pyrolysis of polystyrene to give the monomer is relatively simple, but other problems arise. For example (40) gives procedures for the determination of polystyrene in styrinated alkyd and epoxy resins, and (41) advises the use of ultra-violet spectroscopy for estimating the amount of residual monomer in the polymer.

Polyvinyl Chloride

As with all other polymers the problem of isolating it from plasticizers, fillers, etc., is a difficult one.

Ether extraction is recommended (42) for removing the plasticizer, followed by a solution of the polymer in tetrahydrofuran to free it from the fillers.

The quantative estimation of polyvinyl chloride, and its copolymers with vinyl acetate, is covered by (43). Pyridine and alcoholic caustic soda are used (44) to identify the polymer. It should be noted, however, that neoprene and hydrochlorinated rubbers also give a faint colour reaction. Morpholine is used (45) to differentiate between polyvinyl chloride and polyvinylidene chloride. Methods for the determination of chlorine are given (46), (47).

Polymethyl Methacrylate

This polymer is easily depolymerized by pyrolysis (11) and information of value for identifying the monomer by infra-red spectroscopy is given (48), and vacuum depolymerization after removal of the plasticizer is recommended (49).

Determination of residual monomer in the polymer is given in (50), (51).

Cellulosics

A method of analysis of cellulose acetate is given (52) and cellulose acetate butyrate (53).

The amount of esterification, or etherification, can be estimated by the following methods:—

1. Acetyl and butyl values (54).
2. Acetyl values (55).
3. Ethoxy content (56).

Methods are given for estimating nitrate nitrogen (57), the free hydroxyls (58), and free acid (59). This latter measurement is important for determining the quality of reworked nitrocellulose.

Nylon

Most methods for the identification of the various nylons are based on chemical breakdown by heating with hydrochloric acid, followed by identification of the products of hydrolysis. Infra-red spectroscopy is used (60), and a method for separating these products is given (61). Chromatographic methods of estimation are given in (62), (63), and with potentiometric titration of the products of hydrolysis (64).

A direct chromatographic examination is described (65).

A colour test differentiating between nylons based on adipic acid and Terylene is given (66). An infra-red spectroscopic method for detecting N-methylation of nylons is described (67).

Reference may also be made to (19), (68).

Silicones

The chemical analysis of silicones is given (69) and their infra-red spectroscopy (70).

Polyurethanes

Most of the methods given in published work

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on the identification of polyurethanes depends on infra-red spectroscopy (71), (72), (73).

Polyesters

There is a very complete method of identification of dicarboxylic acid used in polyesters (74). It deals with adipic, citraconic, itaconic, fumaric, maleic, phthalic and sebacic acids. Data is given on vapour pressure, saponification value, ultra-violet spectra, infra-red spectra, refractive indices and densities.

Twenty-eight polyhydric alcohols are treated in a similar manner (75), and the acidic and alcoholic components of polyesters are determined (76).

A modification of the Kappelmeier method for determining phthalates in alkyd resins is given (57), and a method for determining the chlorine content of alkyd resins modified with vinylchloride-acetate copolymers is described (77).

Epoxy Resins

An estimation of epoxides is given (78) and should prove of use. See also (79).

Phenol-formaldehyde Resins

Raw material control is of major importance in the production of phenol-formaldehyde resins. Methods for estimating phenol and cresols are described (80). Determination of ortho cresol by the formation of a complex with cineole is given (81), and for meta cresol by nitration (82).

Phenolic resins often contain residues from the chemicals used in their manufacture and a note on the determination of free formaldehyde is given (83), of hexamethylene tetramine (84), (85), and of free phenol and cresols in phenolic resins (86), (87).

Urea and Melamine Resins

Resins from urea alone, or in combination with formaldehyde, can be identified and estimated quantitatively by several methods (88), (89), (90), (91).

The identification of urea-formaldehyde and melamine-formaldehyde in paper is given in (92), and the method is equally applicable to other forms.

A complete analysis of urea-formaldehyde resins is found in (93), glue lines are covered in (94), and thiourea in (95).

A rapid method of identification of wet-strength resins in paper is given (96).

Plasticizers

After extraction by a suitable solvent, such as alcohol or ether, ester plasticizers can be hydrolyzed by boiling with dilute caustic soda, and the alcohol and acid portions of the ester identified separately. The alcohol may be identified by preparation of the benzoyl deratives (see Schotten Baumann method in any standard organic text book), and the acid by purification from the hydrolyzed plasticizer, and the determination of its melting or boiling point.

A method is described (97) in which a mixture of Skellysolve B and ethyl alcohol (50 : 50) is used. The melting points are listed (98) of the p-nitro-phenyl hydrazones of all the alcohol acetoacetates that are commercially available. This can be of use in identifying the alcohol in the hydrolysis product. Nineteen plasticizers are covered in (99) and it is very complete, concluding with a lengthy discussion on their infra-red spectra.

Plasticizers specifically used in polymethyl methacrylate are discussed (100), (101), phthalate esters (102), (103), and polymeric esters (74), (75).

There are a number of British (104 to 114) and American (115), (116) Specifications dealing with individual plasticizers, and will repay study.

The detection of tri-o-tolyl phosphate is required in connection with German food laws. Details will be found in (129).

Fillers

Little information exists on the identification of fillers.

Ashing is advised in the British Specification for vulcanized rubber (24), but for fillers that volatilize wet methods are proposed (24), (117). Similar methods can be used for polyvinyl chloride compounds.

With organic fillers which will be damaged by ashing, solution of the compound followed by isolation of the filler and microscopic examination will be valuable.

Stabilizers, Antioxidants, Catalysts

Alcohol or acetone extracts may be used to identify anti-oxidants (118). It is claimed (119) that ultra-violet spectroscopy is more sensitive than infra-red spectroscopy towards anti-oxidants and accelerators used in the rubber industry.

The determination of small amounts of carbon black used in polyethylene is given (120). A polarigraphic method for determining lead in polyvinyl chloride is described (121).

Iodometric methods for determining peroxide catalysts will be found in (122), (123), and a method for determining water in nylon 6–6 (124) which could be adapted to other polymers.

Shellac

Methods for the analysis of shellac are given (126), (127), (128).

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New Technical Service Building at Welwyn

Big extension to I.C.I. Plastics Division site

FOR many months now visitors to the Welwyn Garden City site of I.C.I.'s Plastics Division have seen a large new building in course of completion. On the September 28 it was officially opened, and constitutes the new home of the Technical Service and Development Department. It is one of the most interesting and most impressive buildings we have seen, and the photographs on this page give some indication of its size and scope.

The Technical Service department has two complementary functions—to give technical service with existing products, and to develop new materials, new applications, and new processing techniques. The new building will facilitate this work by providing the department's staff with the most modern facilities. Apart from new projects yet to come, provision is made for the continuance of such developments as acrylics for street lighting, polythene for cold water supply, p.v.c. for gramophone records and for the continued study of techniques such as injection moulding and extrusion, the fruits of which are disseminated to the industry by means of technical bulletins.

The main block comprises seven laboratories, for moulding, compounding, extrusion, and fabrication, and for butadiene, nylon and "Fluon." They are equipped with full scale and semi-scale machinery and great care has been taken to layout the plant to the precise requirements of each group of research workers.

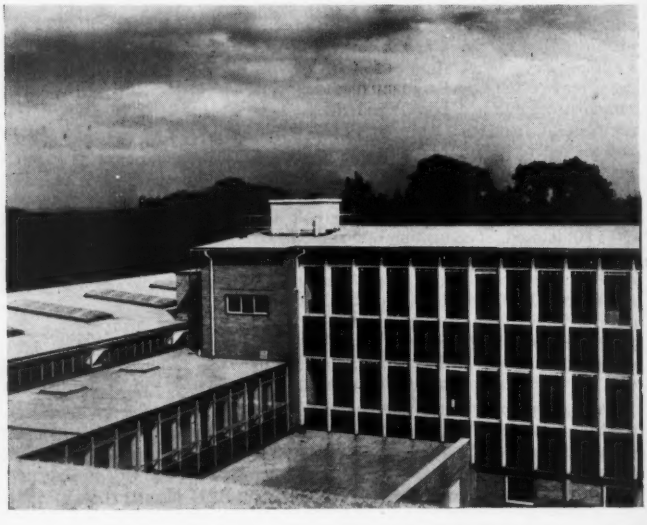
For the opening ceremony, each laboratory put on a series of special demonstrations. For example, in the moulding laboratory a Windsor Autoplas 1044 machine was used to show the versatility of Alkathene for domestic wares. Examples of Alkathene H.D. were also displayed to demonstrate the improved strength/temperature characteristics of this material. Injection moulding with Maranyl nylon was shown with the aid of the Peco 20m and the Edgwick HY machine. These demonstrations were typical of the work of the technical service department as a whole. The demonstrations in each laboratory were further supplemented by large-scale diagram displays. These provided interesting facts and figures on the materials and processes concerned, showing the development, year by year, of, for example, polythene, Butakon, and Fluon.

Two side wings project from the main block, housing laboratories for polythene, Perspex, colour, thermosetting resins, and nylon. At the front of the laboratories is an administrative block in which are also an exhibition room and a conference room.

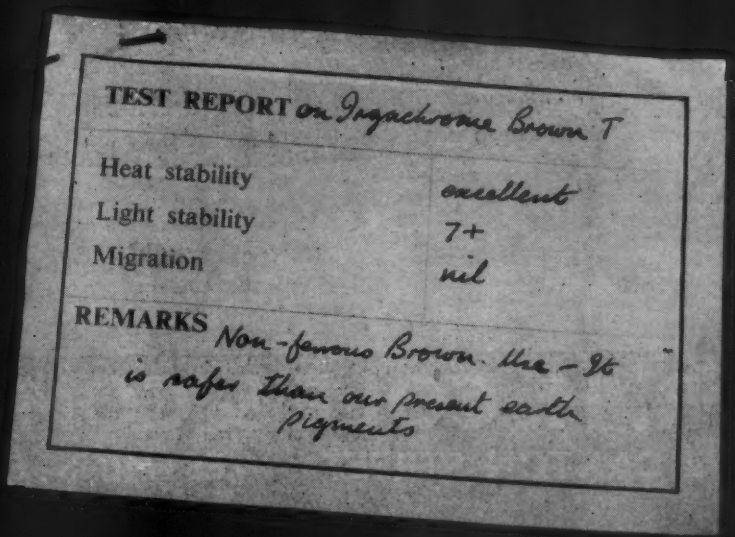
This new building is a show piece, but with a difference. It is functional in the real meaning of the word, and it is a tribute to the architects and to the staff of the Technical Service Department, that they have been able to combine the requirements of a working unit with the aesthetic quality of the structural design and decoration.

(Above) Exterior of the main building.

(Left) View through the main series of laboratories.



(Below) A view from the top of one of the laboratories.



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Aryl Phosphate Plasticizers in Modern Plastics Processing

A review of their properties and present applications in the plastics industry

THE aryl phosphates have been established as plasticizers for natural and synthetic resins for close on fifty years and today, in a wider field and with improved manufacturing techniques, this group of plasticizers maintains an unequalled degree of popularity.

In 1910, the use of triphenyl phosphate as a plasticizer for cellulose esters was patented by W. G. Lindsay (E.P.10,794), and during the 1914–18 war tritolyl phosphate (or tricresyl phosphate as it was then known) became indispensable to the manufacture of nitrocellulose dopes and lacquers. It says much for the efficiency of these two plasticizers, that both are still widely used for these purposes.

With the advent of plastics based upon polyvinyl chloride and its copolymers there arose a demand for plasticizers which would withstand the more severe processing conditions necessary for the compounding of these materials, and tritolyl phosphate was again found eminently suitable. However, the rapid rise in the production of p.v.c. compounds during and after the second world war increased the demand for plasticizers by leaps and bounds, and put a severe strain upon the supplies of cresols available for the manufacture of tritolyl phosphate. The strain was relieved by the timely introduction of another aryl phosphate plasticizer with properties akin to those of tritolyl phosphate—namely trixylyl phosphate. Many other types of plasticizers have subsequently been produced, but the attributes of these aryl phosphates are such that they are still amongst the most widely used in the plastics industry. The 1955 production of tritolyl and trixylyl phosphates in the U.K. alone has been estimated as being in excess of 11,500 tons.

Improved Techniques

The improvements in modern plastics machinery and processing techniques, coupled with the ever-widening use of p.v.c., have meant that the requirements of a plasticizer have undergone considerable change since the days when tritolyl phosphate was first introduced. In fact, it has been found that no single plasticizer is ideal in all respects—all those commercially available having both virtues and shortcomings. For this reason, it is common practice to use mixtures of plasticizers which enable the p.v.c. compounder to take advantage of the desirable properties of each component of the blend; and by this means it is possible to formulate plasticizer mixtures to meet particular service requirements. For example, it will be seen from the following table that although the aryl phosphates impart such desirable properties as ease of processing, flame-retardance, good resistance to extraction by oil and excellent ageing characteristics, they are not as good as other plasticizers with respect to low-temperature properties; and a p.v.c. compound plasticized with an aryl phosphate alone to the desired flexibility at normal temperatures, will harden considerably at lower temperatures. For many applications this is of no disadvantage, but where good low-temperature flexibility is required, this weakness may easily be offset by using tritolyl phosphate or trixylyl phosphate in conjunction with a plasticizer possessing especially good low-temperature properties, such as one of the higher alkyl sebacates or adipates.

COMPARISON OF THE PROPERTIES OF PLASTICIZERS FOR P.V.C.

	Tritolyl Phosphate/ Trixylyl Phosphate	Higher Alkyl Phthalates	Higher Alkyl Sebacates
Ease of processing ...	excellent	good	poor
Flame-retardance ...	excellent	poor	poor
Low-temperature properties... ...	poor	good	excellent
Plasticizing efficiency	fair	good	good
Ageing characteristics	excellent	fair	fair
Oil-resistance ...	excellent	poor	poor
Heat and light stability	fair	good	good

An overriding consideration these days is competitive costs in manufacture, i.e. articles must be produced at the lowest possible cost and at the highest quality obtainable at that cost. Modern machinery has put the accent on speed, and the tendency over the past decade has been to produce goods more quickly at the same running and operating costs, with a reduction in labour. Translating this into p.v.c. techniques, the requirement nowadays is for a plasticizer which gives the most rapid gelation at elevated temperatures and possesses a series of properties which can be summarized as "quick processing." In this respect, the aryl phosphates are still a long way ahead of other commercially available plasticizers.

In addition to rapid processing, the solvent and gelling properties of the aryl phosphates for p.v.c. resins are responsible for a number of other important features. At normal room temperatures they can be mixed with paste-forming polymers without causing undue thickening or gelling of the latter, and for this reason they are widely used in the preparation of plastisols and organosols. However, at the elevated temperatures required to gel p.v.c., they are amongst the best solvents for this type of polymer, resulting in rapid and easy compounding and an outstanding tolerance for secondary and extender plasticizers. This property of rapid gelation at elevated temperatures is of value in both spreading processes and hot compounding when speed of throughput is an important factor; whilst the high tolerance for the less expensive extender plasticizers permits the production of cheaper compounds which are still satisfactory in performance. It has been found that the more common extenders can be used in larger amounts in conjunction with aryl phosphates than with phthalate and sebacate plasticizers; whilst such materials as antistatic agents and other special purpose additives, which themselves may not be fully compatible, can be incorporated safely and the risk of exudation minimized.

Together with good processing properties, tritolyl phosphate and trixylyl phosphate have the lowest volatile loss of the monomeric plasticizers. This property, combined with low extraction by oils and other solvents, permits the formulation of p.v.c. compounds possessing excellent ageing properties under normal and even tropical conditions.

Fire Retardence

Another important attribute of the aryl phosphates is their fire-retardant property. It is well known that whilst p.v.c. resin itself is non-inflammable, plasticized compositions based on phthalates and most other alternatives to phosphates will support combustion sufficiently to constitute a fire hazard unless fire-retardant fillers, such as antimony oxide, are employed. The use of such fillers may often be undesirable because of their effect upon other properties of the compound, and it is therefore important to note that p.v.c. compounds plasticized with aryl phosphates (without fillers) are virtually non-inflammable.

A certain amount of prejudice about the phosphate esters was rife in the early 1940's and, amongst other things, allegations regarding toxicity were made. It is now accepted that, in common with many other materials used commercially on a wide scale, the aryl phosphates are toxic substances and, in view of the possibility of extraction by oils and fats, etc., it is therefore considered inadvisable to employ them in the manufacture of goods which are to be used in conjunction with foodstuffs (such as wrappings, containers, etc.) or which are likely to be in prolonged and intimate contact with the skin. Nevertheless, their use in other types of plastics products cannot be considered harmful and it is now generally recognized that, provided these plasticizers are employed as intended, no real hazard is involved, either in compounding or after use. In fact, the author knows of no authenticated case of poisoning occurring when either tritolyl or trixylyl phosphate has been put to its proper use in plastics materials. The other cause of prejudice was the quality of the product manufactured formerly. Today, however, the standards of manufacture have been vastly improved, and the colour, colour-stability, odour, and freedom from impurities have been brought to a very high level. Recent developments have resulted in the availability of grades of tritolyl and trixylyl phosphates with considerably improved heat and light stability, although it is agreed that they are not superior to the phthalate plasticizers in this respect. Nevertheless, the new grades, especially when used in conjunction with epoxidized oil or thio-organo-tin stabilizers, are most effective and, when properly formulated, can be used to give compounds equivalent to those containing phthalates.

An important advantage of the new grades is that they may be used in the production of p.v.c. compounds which are practically free from odour. This is a result of three factors: (1) freedom from initial odour in the phosphate itself, (2) good stability in processing, and

(3) low volatility. In a recent trial, p.v.c. compounds were prepared using a wide range of plasticizers, and these were judged by an independent panel of specialists. In every case, the sheets plasticized with the new grades of aryl phosphates were adjudged superior on odour value to those containing phthalates or sebacates.

With the adoption in most plastics factories of modern close costing techniques, it has become more obvious that the true cost of the plasticizer used is not simply a function of its initial price per pound. Such factors as plasticizing efficiency and the volume relationship to the resin play most important roles in the true costing. The technical factor which governs the amount of any plasticizer which may be used to produce a compound of a given flexibility is its " plasticizing efficiency " and it will be apparent that, in the case of plasticizers which are cheaper than the resin, it is often an advantage for them to have limited plasticizing efficiency, for in such cases a large proportion of plasticizers may be incorporated in a compound and thus permit it to be produced at a lower cost. Tritolyl phosphate and trixylyl phosphate do not produce such flexible p.v.c. compounds at normal temperatures as equal weights of many other commercially available plasticizers and thus a higher proportion of the phosphate must be used to produce a given flexibility.

In connection with the latter consideration, it is important to bear in mind that the tensile strength of a p.v.c. compound is more closely related to flexibility than to plasticizer content. In fact, p.v.c. compounds plasticized with aryl phosphates have a slightly higher tensile strength than those plasticized with phthalates to the same flexibility at normal temperatures.

Although most p.v.c. resins are cheaper than plasticizers on a weight basis, when compared on a volume basis it is found that, because of the higher density of p.v.c., some plasticizers are in fact cheaper than the resin. This is a most important factor in cases where the compounding materials are bought on a weight basis whilst the finished article in which they are incorporated is sold on a volume basis. Tritolyl phosphate is the same price per unit of volume as p.v.c. resin at 1s. 8½d. per lb. whilst trixylyl phosphate is cheaper. From the point of view of the manufacturer who produces sheet, extrusions or mouldings to certain dimensions it is no disadvantage to use a relatively large amount of tritolyl phosphate, whilst the more trixylyl phosphate which is used, the cheaper the compound becomes.

The requirements of plasticizers in modern plastics processing are both exacting and varied and, although research continues, no single commercially available product embodies all the desired qualities. However, from the foregoing notes it will be seen that the aryl phosphates have much to commend them and with the recently improved standards of manufacture, they will undoubtedly retain for many years to come their present important position in the world of plastics.

Education and Plastics 1956-57

FOR the benefit of prospective students we give details of various courses and lecture series being presented at centres in different parts of the country on plastics or allied subjects. For more detailed information, application should be made to the Principal or Head of Department at the respective centres.

London: Acton Technical College, High Street, Acton, London, W.3.

Advanced courses in the chemistry and technology of plastics materials and also for machine and mould design are being held for part-time students studying for the Associateship of the Plastics Institute examination. For students wishing to study for the Diploma of the Plastics Institute and City and Guilds of London Institute examinations a part-time day course has been arranged extending over three years.

Two higher technological courses on plastics have also been arranged. The first a course of six lectures is on materials and processes, and the second a course of 30 lectures is on high polymer chemistry.

London: Borough Polytechnic, Borough Road, London, S.E.1.

Both evening and part-time day courses for the D.P.I. and City and Guilds of London Institute examinations have been arranged. These courses extend over a period of five years. A three-year Associateship course for students possessing the Diploma can be taken as a part-time day course or as an evening course for the first year. Advanced evening courses have also been arranged. One is an introductory course on plastics technology for science graduates and the other a course on organic and physical chemistry of high polymers. Suitable laboratory courses are also in preparation.

London: National College of Rubber Technology, Northern Polytechnic, Holloway Road, London, N.7.

Two full-time courses for the A.P.I. are being held. The first a three-year course is for candidates of suitable G.C.E. standard, and the second a one-year course is for students having a university degree or similar qualification.

Part-time courses include a two-year evening course for the City and Guilds examinations and Certificate of the National College of Rubber Technology, a two-year part-time day release course for graduates (three years for non-graduates) preparing for the A.P.I. and a two-year evening class for graduates (three years for non-graduates) also for the A.P.I.

Birmingham: Birmingham Technical College, Suffolk Street.

Part-time day release courses for the A.P.I. examination and also for the City of Guilds of London Institute examination and D.P.I. examination are to be held. Full details and the prospectus can be obtained from the Chemistry Department of the college.

Manchester: Newton Heath Technical College, Manchester 10.

Courses are available leading to the Intermediate and Final Examinations of the City and Guilds of London Institute and to the Diploma and Associateship of the examinations of the Plastics Institute. The courses involve attendance on one day or on three evenings per week. Details and syllabus can be obtained from the Applied Science Department.

Other Lectures

University of London.

The Extra-Mural Department of the University is holding a course of 10 lectures and discussions on Friday evenings at 6.30, commencing on October 12. This course, with the title of Technology and Industry, contains a lecture by Mr. A. Renfrew of I.C.I. Ltd., entitled " Plastics in Perspective " on November 9. Further details can be obtained from the University of London, Senate House, Malet Street, London, W.C.1.

THE PLASTICS INSTITUTE ASSOCIATESHIP EXAMINATION, 1956

The examination was held from June 11 to 14 at the following centres: Acton Technical College, London; National College of Rubber Technology, London; College of Technology, Birmingham; Newton Heath Technical College, Manchester.

Names of Successful Candidates

S. F. Brailsford, C. W. Perkins, G. M. Wells (Birmingham); D. J. Brown, R. J. de Vries, R. W. Hogg, K. Knowlton, S. G. Maskell, L. N. Phillips, B. Shoop, P. J. Thompson (Acton); E. E. Gunn, R. H. Hawker (N.C.R.T.); B. A. Rowbottom (Newton Heath).

CITY AND GUILDS OF LONDON INSTITUTE EXAMINATIONS LIST OF PASSES, 1956. INTERMEDIATE EXAMINATION

Borough Polytechnic:—Ivar Andersen (2nd), Roy Baxter (1st), Michael Cox (2nd), John Dando (2nd), James Hawkes (2nd), James Hughes (1st), Peter Hyland (2nd), Patrick Johnson (2nd), Peter Lyon (2nd), Clive Maier (2nd), John Millard (2nd), David Miller (2nd), Michel Rozenblat (1st), Joseph Smith (2nd), Ralph Snudden (2nd), Gerald Whiting (2nd), William Whiting (2nd).

Birmingham College of Technology.—Kenneth Barrell (2nd), Roy Caswell (2nd), Alfred Green (2nd), Barry Jones (2nd), Clifford Knight (2nd), Laurance Mann (2nd), Keith May (2nd), Donald Morgan (2nd), Bryan Pegg (2nd), Mervyn Richardson (1st), Keith Shelley (2nd).

Cardiff College of Technology.—Stanley Smith (2nd), Harold Disley (2nd), Harold Boudier (2nd).

Stroud & District T.C.—Peter Caldwell (2nd).

Newton Heath T.C., Manchester.—Alan Ashworth (1st), Ronald Cooke (2nd), Clifford Greenhalgh (2nd), Thomas Greenwood (2nd), Vincent Shaw (2nd).

Northern Polytechnic, London.—Reginald Gardner (2nd), William Neal (2nd), Gordon Forbes (2nd), Anthony Miller (2nd), Maurice Eyre (2nd), John Shawley (2nd).

St. John's School of Printing, Newcastle-upon-Tyne.—Kenneth Douglas Barnes (2nd).

Final Exam. results will be published next month.

Book Reviews

Polyesters and their Applications.

By J. Bjerksten. 618 *pages.*
Reinhold Publishing Corporation (Chapman & Hall, Ltd., London). 80*s.*

This is the third volume to appear recently on polyester resins and their application in plastics. It is the most important because it contains a massive collection of literature references, very clearly classified and grouped, and providing complete coverage up to and including 1953. It is a source book of a very high order indeed.

Preceding this bibliographical information is a series of chapters on fabricating techniques, chemistry, and applications. This part of the book is far less comprehensive and informative. An extraordinary feature is that only two illustrations appear in the whole work; one is a flow sheet for the manufacture of polyester resins, and the other a diagram of a resin kettle. This deficiency is both surprising and disappointing, since the fabrication of polyester structures, an essentially practical process, cries out for illustrations and photographs. The reader would want to see drawings of mould assemblies, methods of lay-up, preforming techniques and the like.

Plastics for Corrosion-Resistant Applications.

By R. B. Seymour and R. H. Steiner.
Reinhold Publishing Corporation (Chapman & Hall, Ltd., London). 60*s.*

In common with the volume referred to below on vacuum coating, this book is highly specialized, authoritatively written, and startling in its completeness. For example, unlike many books, its general introduction, dealing with the physical properties and testing of plastics is slanted at the main topic—corrosion resistance. The information is to the point and adequate, and the reader's time is conserved for what follows.

A most valuable section deals with the selection of plastics for the solution of corrosion problems. An ingenious chart is supplied which evaluates the complete range of plastics materials in terms of a number scale from 1–10. The subjects listed in this way include cost, specific gravity, maximum service temperature, resistance to alkalics, acids and oxidation. Thus for each material a total can be obtained which offers a comparative guide. Polythene rates 72, against silicone which gets 43.

In these days when problems of corrosion are of greater importance than ever before, engineers in all branches of industry will find this book of great value.

British Standards Institution Annual Report, 1955-56.

258 *pages.*
Published by the Institution. 5*s.*

The work of the British Standards Institution needs no praise here; the plastics industry has cause to be specially grateful that through the Institution it has, over the years, been able to progress so rapidly to standardized and better quality products. The annual report is always worth reading, even if only as a reminder of the immense amount of work done each year.

Chemical Market Research in Practice.

Edited by R. E. Chaddock. 196 *pages.*
Reinhold Publishing Corporation (Chapman & Hall, Ltd., London). 24*s.*

Based on a series of lectures presented by the Chemical Market Research Association of the U.S.A., this book has as its purpose the disclosure of basic facts to assist executives to obtain a better insight into the complicated techniques and practice of chemical market research. A miniature history of the growth and organization of the chemical industry is supplied as a background to the subsequent chapters which deal with such complex topics as integrating research and development with market research, policy planning and finance, etc.

Of special interest is the chapter on the plastics industry, written by I. R. Williams, Jr. and R. W. Crawford, the latter being manager of business research in the plastics division of the Monsanto Chemical Company of America, Here a typical market research project is analyzed, the example being polystyrene. A chemical company considering entering the polystyrene field would need to have the following questions answered:

(1) Current producers and capacities, including plants under construction.
(2) Current market distribution by end products, major fabricators, their current suppliers, quantities used.
(3) Current market distribution geographically.
(4) Probable future market distribution geographically.
(5) Future market distribution by end products, near-term and long-term.

The cost of an adequate market research programme to cover these questions would be in the order of £25,000–£30,000. A heavy price, but not startlingly so when compared with the cost of the plant to manufacture polystyrene.

Although based on American experience this book will be read with interest by all who are concerned with raw material manufacture.

International Symposium on Macromolecular Chemistry.

952 *pages.*
Interscience Publishers, Ltd., London.
19 *dollars* 20 *cents.*

An international congress is always a mixed bag of tricks. Venerable scientists reiterate oft-repeated truisms, side by side with the evangelists of new developments, who choose a symposium as the launching ground of a new technique, a new theory, or a new material. Often of far greater importance than the papers read is the exchange of information during private discussions between scientists of different countries.

With this proviso therefore, the published papers of the 1954 symposium in Milan offer some fascinating reading, in parts. Of special importance is the paper by Dr. Giulio Natta on the kinetics of polymerization of ethylene catalyzed by alkyl-aluminium compounds. Drs. Ziegler and Natta have opened entirely new fields of development both from the viewpoint of manufacture and application, and any published information on the polymerization of ethylene and styrene at low pressures will be read with great interest.

One aspect of this book calls for attention; it is exceedingly well produced, with summaries in German, Italian and English. One might almost describe it as a model example of how to publish a set of symposium papers.

Plastics Progress 1955.

Edited by Phillip Morgan. 432 *pages.*
Iliffe & Sons, Ltd., London. 50*s.*

This volume is probably the last to serve as a record of a purely British plastics convention. The 1957 convention will, we understand, be international in character. That this is a good thing will be obvious to the reader of "Plastics Progress 1955," for a purely national symposium is bound to lack the sparkle and originality of its international counterpart. A man may feel constricted in discussing his subject in his own country, whereas some freedom for manoeuvre is experienced abroad. The competitive element is also markedly absent in the parochial meeting.

We look forward therefore to the 1957 convention, and meanwhile commend the present volume under review to those who were unable to attend the conference in person. It is valuable for its full record of the discussions following each paper, and will especially appeal to the reader overseas as a window on current British practice in plastics.

The Chemistry of High Polymer Degradation Processes.

By Norman Grassie. 335 *pages.*
Butterworths Scientific Publications. 42*s.*

The word "degradation" will, to the chemist, cover a multitude of sins. Scission of weak bonds, oxidation, and depolymerization are all examples of degradation. How it occurs, and when, is sometimes of academic interest, but much more frequently a matter of great importance. This is particularly true of high polymers, where degradation may occur from natural causes, unassociated with exterior influences such as heat.

Dr. Grassie has set out to examine degradation in high polymers in terms of chemical structure, and has produced a comprehensive work which will be of the greatest use to a number of groups of people. For the specialist in polymer chemistry, this book will afford a valuable set of references in a field comparatively unknown. Industry will be guided by its conclusions in as much that weathering and deterioration processes affect plastics materials usage.

Prior to the appearance of Dr. Grassie's book, we had little to guide us in approaching degradation as a chemical change; investigators can now start with a complete knowledge and with guiding principles, a valuable stimulus to further study of this fascinating problem.

Vacuum Deposition of Thin Films.

By L. Holland. 570 *pages.*
Chapman & Hall, Ltd. 70*s.*

Mr. Holland is specially qualified to write on the subject. He is the head of the vacuum coating research laboratory of Edwards High Vacuum, Ltd. We are not surprised therefore to find that he is a complete master of his subject. What is fascinating is the immense mass of information he has been able to bring

together, in terms of sheer bulk; an interesting demonstration of the manner in which our industry is growing. Ten years ago one considered oneself lucky if a pamphlet could be found on such specialized subjects. Today we have the monograph.

Mr. Holland's book achieves neatly an adequate balance between the pure physics of metallic evaporation and vacuum, and the essentially practical technology of coating plastics toys, and constitutes a complete work of reference on a field hitherto little known, The fact that it exists means that for the first time researchers will have at hand a comprehensive review and the technological development of thin films will benefit accordingly.

The Chemistry of Phenolic Resins.

By Robert W. Martin. 298 *pages.*
John Wiley & Sons, Ltd. (*Chapman & Hall. Ltd., London*). 76*s.*

The blurb on the dust jacket claims that this is the only detailed survey in English to cover both the chemistry of present day phenolic resins and the chemistry of the related products. Now apart from the several excellent works on phenolic resins already published, probably no other branch of resin chemistry has received as much attention as the phenolics. They represent the quintessence of classical research.

The point that distinguishes this book, making it noteworthy despite all that has been published before, is that Mr. Martin has taken special pains to prepare a most comprehensive set of literature references. For the rest, it offers little which is not already available.

Organic Chemistry.

By L. F. and M. Fieser. Third Edition. 1112 *pages.*
Reinhold Publishing Corporation (*Chapman & Hall, Ltd., London*). 50*s.*

The present writer is not sure how many textbooks on organic chemistry are currently in print, but there are very many. The choice of the student therefore will be governed by the reputation of any particular work, taking into account the fact that each book usually has specially good chapters on specific topics. One will deal very well with proteins, another excels in its treatment of stereo-chemistry. This specialization is due to the inevitable bias of the author who, when dealing with his own subject, writes with greater authority than on the field of organic chemistry as a whole.

This book by Drs. Louis and Mary Fieser may be judged as the exception to this rule. It is a good all-round book, essentially designed for the student, and certainly well arranged. Such discrepancies as it has are inevitable in an omnibus work which seeks to encompass so much basic material in a thousand pages. The chief criticism is that its literature references are too few in number. It deserves special praise for an exhaustive author and subject index.

Plastics Technical Dictionary—English/German.

By A. M. Wittfoht. 388 *pages.*
Carl Hansler, Munich. 38 *D.M.*

Anybody who has had to grapple with the German literature will have experienced the exasperating lack of good technical dictionaries, especially a dictionary specifically based on plastics technology. Mr. Wittfoht has filled the breach and produced a most admirable work. It is practical and comprehensive and will be a very welcome addition to technical libraries.

Patent Review

The following abstracts have been made from specifications at the Patent Office, with the permission of the controller of H.M. Stationery Office. The country of origin for Convention Applications is shown in parentheses. Complete specifications can be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2, price 3s. 0d. each (including postage).

B.P. 751,467. Apparatus for agitating liquids. J. Z. Bruton.

A dish with two or more compartments for treating (washing) photographic prints. The dish is rockable because of the curved shape of its underside or a moulded transverse ridge.

B.P. 751,468. Electrically conductive windshield. To: Libbey-Owens-Ford Glass Co. (U.S.A.).

With an interlayer of thermoplastic material between the glass sheets.

B.P. 751,490. Concrete form and method of moulding concrete columns herewith. J. E. Copenhaver, B. De S. Clarkson, A. Woods Jr. To: Sonoco Products Co.

Paper tubes as concrete forms lead to difficulties in stripping them from the concrete after it has set. They may be conditional for use by providing them with a liner film of polyethylene. The concrete exhibits, afterwards, an excellent surface finish.

B.P. 751,501. Non-thermosetting water-soluble melamine resins. To: British Industrial Plastics Ltd. (U.S.A.).

B.P. 751,514. Packaging of sausage casing gut. To: British Canadian Casings Ltd. (U.S.A.).

In flexible polythene tubing.

B.P. 751,528. Inter-electrode separators for electric cells. To: Yardney International Corp. (U.S.A.).

Made from a sheet of unplasticized polyvinyl alcohol. In order to lower its electrolytic resistance, the sheet is immersed in methyl or ethyl alcohol and then air dried.

B.P. 751,577. Method of manufacturing a shuttlecock. W. C. Carlton. To: Carlton Tyre Saving Co. Ltd.

Relates to shuttlecocks with a skirt made in one piece of plastic material by a moulding process. The lower skirt is stretched after the initial forming process.

B.P. 751,584. Packages. To: Tubophane S.à.R.L. (France).

A receptacle of cylindrical (oval; polygonal) section with upper and lower openings is made from a flexible (transparent) plastic with beadings around the upper and lower edges reinforced by rings of plastic or steel (piano) wire. Cardboard discs form base and cover held in place under the beadings by the material itself.

B.P. 751,593. Uniting thermoplastic sheet materials and other sheet materials. C. Jetschmann, M. Jetschmann. To: Europlex Ltd.

Pieces of thermoplastic sheets and woven textiles are frequently stitched together to form bags, curtains, personal wear. Owing to the perforation the line of union is easily torn. If woven textile material is foraminated in the area of union and the plastic sheet covers this area on both sides the application of heat (high frequency) and pressure produces a plurality of coalesced extrusions into the foraminations to form a secure union. Used, e.g., for uniting plasticized polyvinyl chloride and woven nylon fabrics, for slide fastener tapes, curtain materials.

B.P. 751,627. Holders for beakers, drinking glasses, tumblers and the like. G. A. Elliot. To: B.E.F. Products (Essex) Ltd.

A band with an integrally moulded handle.

B.P. 751,634. Ashtrays for smokers. H. H. L. Lohnberg.

Ashtray with figure (man, volcano, locomotive) having an interior passage so that smoke from a cigarette end on the tray rises to an opening on top (mouth, smokestack, etc.).

B.P. 751,655. Filter elements for filters. To: Fram Corp. (U.S.A.).

A cartridge for filtering air in the shape of an annulus of pleated porous paper sealed in a rigid casing by a gasket. Seal and gasket are integrally moulded by slush moulding or dip-coating in a cold state.

B.P. 751,674. Button or ornament head assemblies. B. M. Weber. (U.S.A.).

The head has a semi-elastic insert of a resilient plastic material (polyamide type, vinyl type, polyethylene, cellulose acetate butyrate). The head is attached to a shouldered stud. The stud may also be of a resilient semi-elastic non-metallic material.

B.P. 751,676. Shock proof package. E. R. Ryno, W. M. McKillop Jnr. To: M. McC. Hoover.

A flexible tube encloses the article (e.g. supplies, instruments dropped by parachute) by being twisted around it within a cylindrical shell. Plastic films of the polyvinyl group or the rubber group can counter the shortening effect by stretching.

B.P. 751,706. Moulding machine adapted for plasticizing a thermo-plastic material or a thermosetting material which is subsequently to be moulded. C. K. Marlow. To: Alfred Herbert Ltd.

An electrical induction heating apparatus is incorporated operable at normal power frequencies.

B.P. 751,712. Suspension members for hanging files, cards, zig-zag files or the like. To:: N. V. Kantoorboekenfabrick Atlanta (Netherlands).

B.P. 751,716. Machines for the injection-moulding of thermo-plastic material. T. Dymsza. To: Asmidar Plastic Moulding Machines Ltd.

In order to deal with a much wider range of moulds, materials, temperatures and pressures, the jaws gripping the mould are adjustable by a clamping cam and are mounted on an adjustable carrying plate. The nozzle is vertically adjustable in relation to the mould carrier and is also laterally adjustable.

B.P. 751,744. Bottle seals or closures. S. I. Hitchcock. To: M. & E. Projects, Ltd.

A polyethylene cap with a bulbous protuberance to fit snugly into the bottle neck.

B.P. 751,799. Orthopædic bandages and the preparation thereof. To: American Cyanamid Co. (U.S.A.).

A flexible backing material is coated with a dry mixture of powdrous plaster of Paris and an uncured water soluble melamine-formaldehyde resin.

B.P. 751,924. Machine for printing filled flexible plastic containers. H. M. Hayward (Australia).

Printing can be effectively applied by using a metal stereotype which will take inks having an affinity to plastic. Printing is done by rolling contact.

B.P. 751,932. Elastic roller and method of manufacturing the same. R. G. Kupper.

A steel wool layer wrapped around a central metallic shaft is surrounded by an outer layer of an elastic thermoplastic (polyvinyl) composition having a smooth external surface. The thermoplastic material penetrates through the steel wool layer and fills all the interstices. For transferring ink in a printing press.

B.P. 751,949. Manufacture of containers. C. E. Entwistle.

For boxes, cupboards, cabins, kiosks, caravans. Frames and sheets forming a peripherally stressed envelope around two spaced frames may be of plastics.

B.P. 751,990. Lamp shades. T. W. Ellis, R. H. Bone.

A shade for a tubular lamp built up in sections formed by pairs of strips in parallel vertical planes and U-shaped cross-plates.

B.P. 752,056. Extruding tubing from plastic materials. To: Owens-Illinois Glass Co. (U.S.A.).

Extruding concentric lengths of tubing between the wall of a hollow body and a mandrel surrounded by a sleeve.

B.P. 759,074. Mechanical finishes on flexible sheet material comprising fully synthetic material and the flexible sheet material thus produced. To: A.-G. Cilander (Switzerland).

The sheet material is first treated by hot mechanical finishing, then subjected to a matting treatment with solvents or swelling agents.

B.P. 752,113. Handles for saucepans and other utensils and containers. F. I. Lewis.

A differently colqured insert in the plastic handgrip part provides a distinguishing element for the handle.

B.P. 752,121. Machine for the fabrication of hardenable foam plastic. To: Spumalit-Anstalt (Switzerland).

The apparatus is characterized by a pneumatic coarse-foam producer and a power-driven horizontally elongated agitator unit.

B.P. 752,160. Bags made from flexible material. A. L. Fisher.

With a tear-tape across the sealed bag secured to the inner surface of the bag and protruding through a longitudinal seam in the bag. An incision is made on either side of the tear tape in the overlapping part of the seam.

B.P. 752,167. Combination article of jewellery and scent dispenser. To: Richelieu Corp. (U.S.A.).

A pendant, e.g. pearl-shaped type of body contains a hollow metallic cup-shaped clasp insert for holding a wad of cotton or wool fibre to be wetted with a drop of perfume. The pendant may be coated with an alcohol resistant coating (polyvinyl chloride; vinyl chloride and vinyl acetate copolymers; polyacrylonitrile; nylon).

B.P. 752,184. Device to facilitate the threading of needles. A. Pretorious. To: Pretor Patented Products (Proprietary) Ltd.

A plastic body moulded, e.g. in two parts, one containing a chamber with the loop catching steel wire, the other one forming a lid.

B.P. 752,215. Flexible covers for seats. A. Boot. To: Evertaut Ltd.

Faced with, e.g. polyvinyl chloride over a sponge-rubber filling to be placed on a sheet metal pan. A skirt from an extruded polyvinyl chloride strip is heat welded to the cover and resiliently sprung over the edge of the pan.

B.P. 752,216. Latch for divided articles. W. A. Whysall. To: Newey Brothers Ltd.

Refers to ring combs consisting of two half rings for holding a tress of hair. The two halves are hinged together at one end and latched together by teeth at the other end.

B.P. 752,221. Method and apparatus for forming closed ends on tubes of plastic material. M. Baehr. To: Tubophane.

An extruded polyvinyl chloride tube is cut into desired lengths. The tube end portion is then hot preformed over a mandrel by a first tool, stabilized by a second cold tool and the end finished by dielectric heating.

B.P. 752,238. Coating compositions and processes for the preparation thereof. To: E. I. Du Pont de Nemours & Co. (U.S.A.).

Paints, lacquers, varnishes, adhesives containing halosulfonated polyethylene.

B.P. 752,265. Manufacture of polyvinyl chloride resin. To: Wingfoot Corp. (U.S.A.).

Polymerization of a homogenized water dispersion of liquid vinyl chloride monomer droplets of a certain size for plastisol and organosol applications.

B.P. 752,299. Method of forming hollow plastic articles. To: Owens-Illinois Glass Co. (U.S.A.).

Continuously supplied plastic tubing is successively severed into measured lengths, the severed length transferred to a mould and expanded in the mould by fluid pressure.

B.P. 752,303. Protective head covering. R. W. C. Dehesdin (France).

A moulded shell of thermosetting plastic reinforced by layers of glass fibre to be worn under a hat. The layers are progressively reduced towards the edge of the shell which thus retains its flexibility to fit closely on to different shapes of heads.

B.P. 752,433. Material for and process of patching cellulosic material. To: American-Marietta Co.

Open cavities in the outer sheets of plywood are patched with a thermosetting resin which foams upon application of radiant heat. The material expands with finely divided cells.

B.P. 752,440. Mosaic Pastime. P. Malenge (France).

With pegs having eccentric heads to be inserted in a plate with numerous holes.

B.P. 752,513. Resiliently backed plastic bearing. J. B. Thomson (U.S.A.).

A nylon liner relatively thin and moulded to the correct curvature with a compensation gap to allow for expansion during operation is resiliently held by an intermediate rubber sleeve or other resilient member compressed radially between housing and liner. Polyethylene, polystyrene, methyl methacrylate may also be used for the liner. The bearing can flex and weave with the rotation so as to conform always to irregular rotating surfaces.

B.P. 752,568. Process and apparatus for heat-sealing of films of thermoplastic material. To: Celanese Corp. of America (U.S.A.).

The assembly is carried along and pressed against a driven belt which is heated along one part of its path. The belt is then rapidly cooled from the side opposite to the still pressed-on assembly.

B.P. 752,616. Apparatus for coating wire with extruded insulating material. To: Western Electric Co. Inc. (U.S.A.).

Refers to the control of the degree of expansion of expanded polyethylene as insulating material by regulating closely the temperature, the rate of extrusion and the linear speed of the wire using means for sensing the capacitance of the insulated wire for process control.

B.P. 752,637. Methods for the manufacture of hollow moulded articles composed of a plastic material and having a reduced neck portion at one end of the article. To: Pirelli Societa per Azioni (Italy).

A blow moulding method for bottles in which an excess portion of the extruded tube length is forced into cavities in the mould wall to form attachment lugs for handles moulded in one piece with the body. Further excess material is forced into flash zones.

B.P. 752,643. Stiffening members for soft shirt-collars. M. M. Arias.

A trapezoidal sheet with a plurality of ventilation holes.

B.P. 752,701. Smoker's ash tray with cavities for extinguishing cigarettes. E. P. Aghnides (U.S.A.).

B.P. 752,719. Method of and device for packaging articles in, or producing hollow articles from, foils. To: Hydro-Chemie A. G. für Chemie und Wasserveredelung. (Switzerland).

A first foil is placed on a mould and perforated along a continuous closed line. Then a second foil is forced against the first foil by a vacuum applied through the perforations to form a closed hollow space between the foils. At least one of the foils consists of thermoplastic material.

B.P. 752,720. Containers formed from flexible sheet material. To: Milprint Inc. (U.S.A.).

The mixing container is made as a unitary structure from heat sealable sheet material with a receiving compartment and a secondary liquid measuring compartment having a valved access opening. Certain marginal portions along the edges are bent inwardly and sealed together. Local interruptions leave opening normally closed by valve-like action.

B.P. 752,750. Containers. A. C. J.-M. Anglade, R. P. H. Bichon (France).

A composite container for separately storing substances which undergo changes when stored in mixture (pharmaceutical products; beverages; chemicals). A flask has a tubular insert seated against the bottom and sealed. The insert may be pulled out to cause mixture of the substances in flask and tube.

B.Pl 752,773. Manufacture of containers of barrels from glass fibre mat impregnated or or sprayed with plastic. J. C. Evenblij. To: N. V. Polypress I.O.

Barrels with bottoms having an upstanding flange made from glass fibre mat impregnated with plastic. The bottoms are placed in the barrel body, a glass fibre strip free from plastic is bent around, then impregnated (sprayed) with plastic, which is allowed to harden.

B.P. 752,783. Chest respirators. J. H. Emerson (U.S.A.).

The cage or shield to be positioned on the patient's chest is made from expanded metal dipped in " Vinylite."

B.P. 752,960. Artificial finger and toe nails. E. Hafner (Germany).

(add. to 725,969).

B.P. 752,968. Protected label assembly or the like. D. B. Harris.

A label to be affixed, then lettered and finally protected by an integral transparent cover, which forms a watertight joint around the label.

B.P. 752,975. Transport containers. A. Mauser (Germany).

A container for the transport of polyethylene bags is conical and has removable top and bottom closure rings so as to be used repeatedly.

B.P. 752,992. Toy airplane construction. N. F. Testor (Testor Chemical Co.). (U.S.A.).

B.P. 752,995. Pouring spouts for liquid containers. R. F. J. Dimond.

A tube is attached to the spout. This tube projects into the filling container admitting air until the level of the liquid poured out closes the end of the tube and stops the flow of air. The spout carries an adjustable disc to be set against the mouth of the container to be filled so that the level to which the latter is filled can be determined.

B.P. 753,050. Polymeric compositions, their preparation and methods for preparing shaped articles therefrom. To: E. I. Du Pont de Nemours & Co. (U.S.A.).

Films from polyelectrolyte, particularly polyanionic polymers are highly permeable to moisture. They can be made dimensionally stable, tough and pliable by producing certain blends. For packaging, coating, laminated fabrics of a leather-like structure, as ion-exchange membranes, non-woven webs.

B.P. 753,054. Injection moulding method and machine for use in connection therewith. To: Niederrheinische Maschinenfabrik Becker & van Hullen (Germany).

The spreader (torpedo) inside the moulding cylinder is maintained at a predetermined temperature by selectively cooling or heating through fluid means in response to an increase or drop in its temperature. Thereby the temperature of the moulding cylinder is maintained at an optimum ensuring the plastification of the synthetic material without endangering its composition by overheating.

B.P. 753,066. Coated paper products. To: Rohm & Haas Co. (U.S.A.).

Food wrappers are made of paper coated with cross-linked resin dispersions (copolymer of ethyl acrylate, methyl methacrylate, methacrylic acid).

B.P. 753,099. Flexible container for fluids. A. Dreyer, M. de Toledo (Switzerland).

A pliant plastic bag with a duct of a two-wall flattened part. The walls tend to maintain the duct closed. They are separated by insertion of a mouthpiece.

B.P. 753,142. Cationic urea-formaldehyde resin and processing thereof. To: Hercules Powder Co. (U.S.A.).

For the preparation of a wet strength paper resistant to tearing and breaking, even when wet.

B.P. 753,162. Phenol-aldehyde resins and method of producing the same. D. B. Alexander, H. T. Chamberlain, J. F. Mannion, W. A. Wade, E. R. Bourke, E. W. Schneider, C. S. Urtis, L. J. Gary.

Production of stable compositions which remain liquid under normal atmospheric conditions, which are insoluble (only slightly soluble) in water and normally permanently fusible or thermoplastic.

B.P. 753,236. Receptacles for preserves and similar foodstuffs. H. F. Williams.

A number of dishes with covers clamped around a pillar. The dishes may be moulded from any suitable material.

B.P. 753,248. Means for walking on water. H. S. Short, Jr. (Short Brothers Ltd.).

Two longitudinally rigid floats for the feet of the walker with an inflatable buoyant member each. When inflated they grip the user's ankles. The under face is provided with automatically closing and opening webs.

B.P. 753,250. Flexible liquid-carrying containers. To: International Polaroid Corp. (U.S.A.).

Refers to single use containers releasably containing a liquid which on compression of the container forms, in conjunction with associated materials, a positive photographic print (B.P. 684,592). The new container has a plurality of lengthwise spaced cavities with differential sealing means for directional release of the liquid. The container is suitable for attachment between a photosensitive film and a print material.

B.P. 753,257. Heat sealing means. To: Wingfoot Corp. (U.S.A.).

In order to avoid the thinning out of films under the pressure of heat seal producing jaws and to eliminate interruptions by adherence of the film to the metal of the jaws, the heat conducting metal is provided with a pressure surface covered with a heat conducting material. (e.g. " Silastic ").

B.P. 753,259. Manufacture of expanded polyethylene compositions. To: E. I. Du Pont De Nemours & Co. (U.S.A.).

A mixture of sodium bicarbonate and mineral oil is used producing a small-celled uniformly expanded polyethylene when admixed, heated and agitated under pressure, and finally released after further raising the temperature.

B.P. 753,267. Tobacco pipes. M. C. F. Honisch (Switzerland).

The bowl is made of an outer part of high resistance to fracture, and an inner independent part formed as a solid body of a mass consisting of tobacco constituents and a binding agent.

B.P. 753,277. Aquatic toys. C. Peritz. To: S. Guitermann & Co. Ltd.

With passages in the body for the insertion and discharge of a sinker weight to upset the buoyancy.

B.P. 753,318. Manufacture of moisture-proof heat-sealable sheet wrapping materials H. J. Ward, E. G. Sanderson, M. A. Maloney. To: British Cellophane Ltd.

A thin organic base sheet is coated with a composition comprising nitrocellulose, a gum or a resin, a wax, and a plasticizer of a cyclohexyl citrate.

B.P. 753,374. Art of making bags from thermoplastic sheet material. To: Milprint Inc. (U.S.A.).

Tubular thermo-plastic material (bag forming elements) are heat sealed while travelling between a heating element moving in a defined path and a movable surface, on a conveyor overlying this surface and movable in unison therewith. Separating means travelling with and between conveyor and heating element separate the seamed material from the conveyor when it is clear of the heating element.

B.P. 753,410. Moulding of plastic articles To: United-Carr Fastener Corp. (U.S.A.).

A multi-unit assembly of units is formed by moudling the units simultaneously in a certain aligned relation and then forcing them into assembly prior to removing them from the mould.

B.P. 753,468. Containers for the storage and transport of liquids. P. K. W. Greggains. To: Read, Ltd.

The container has an inner flexible lining of inert material (polythene, polyvinyl chloride) in the form of a bag. The outer rigid body is provided with a flexible spout of inert material collapsible in itself when not in use.

B.P. 753,469. Adhesive bonding process B. J. Balfe. To: I.C.I. Ltd.

For bonding leather to leather and leather to resin/rubber sheet material in the manufacture of shoes. A film of a composition comprising shellac and a phenol aldehyde resin (" Bakelite " products) in proportion between 2:1 and 1:2 is applied to at least one surface and activated by heat or a solvent. The surfaces are held together until bonded.

B.P. 753,477. Reflector for fluorescent lighting. New Era Industries (Tottenham) Ltd., A. R. Pickess.

An elongated plastic moulding in the shape of an oblong trough. A narrow upper channel accommodates the control equipment, a flared lower part acts as an abutment for a reflector back plate covering the upper channel and carrying brackets and hooks. A suitable laminated plastic material is " Darvic " (I.C.I.).

B.P. 753,485. Sheet of material of fibrous cellulose and glass fibrous rovings. To: Hawley Products Co. (U.S.A.).

The tendency of cut glass bundles to disintegrate into individual filaments in water can be overcome by first adding to the water a polyester resin.

B.P. 753,498. Injection moulding machines for plastics. B. J. D. Hupfield.

The heating cylinder functions as a pre-heating chamber on the return stroke after the injection stroke. The cylinder has a rearward and a forward portion provided with heating means and connected by a non-return valve. The injection nozzle is reciprocably mounted in the forward portion.

B.P. 753,593. Cigarette boxes. J. Feusl.

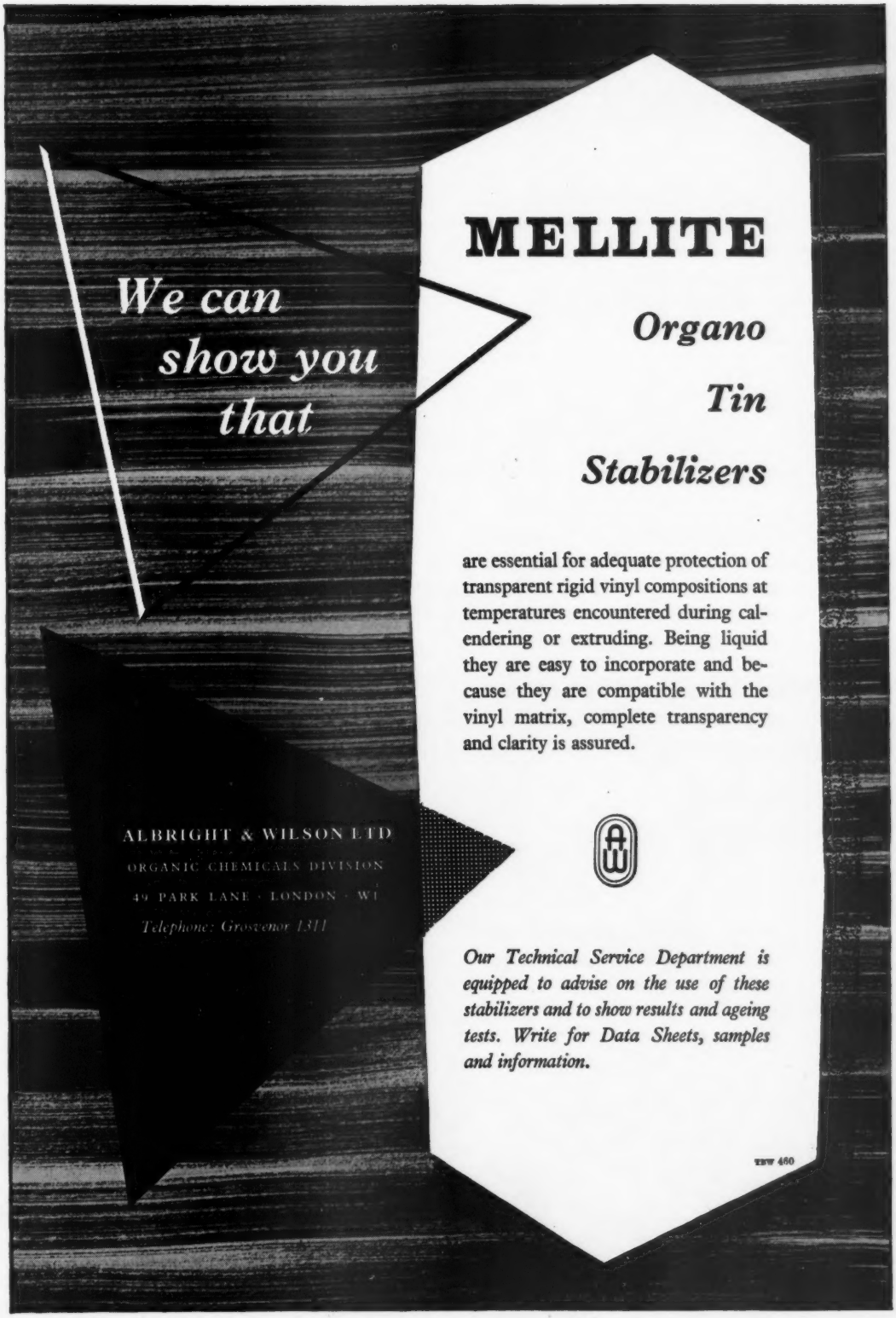
Inside the box is a pivoted tray which can be tilted against spring pressure. A cigarette is then released through an opening onto an inclined bottom plate and rolls out through a slot in the side wall.

B.P. 753,634. Production of laminated material with one surface of synthetic resin which is impervious to water vapour. To: Chemische Werke Huls A. G. (Germany).

A paper web is impregnated or coated with an aqueous dispersion of a copolymer of butadiene and styrene. Then a polystyrene foil is applied less than 25 microns thick under heat and pressure. For keeping commodities fresh. The (colour) printed paper may be used as washable wallpaper.

B.P. 753,655. Manufacture of hollow articles, for example lamp shades, containers, vases and bowls. To: Rotaflex (Gt. Britain) Ltd.

Made of spiral winding a self-sustaining tubular plastic wire or band on a core. The windings are caused to adhere to one another during winding (by adhesives or by solvents and/or plasticizers).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The very substantial grommets at each end of the tank are fitted with special washers to control leakage when the water in tank covers tube in work. An overflow and run-off pipe is fitted at one end of tank. The range of grommets are stored in operator's work tray at side of tank.

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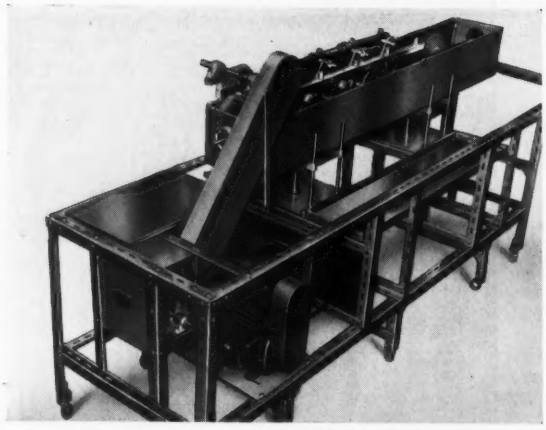
A " Warerite " work table is fitted at front end of tank.

The tank is fitted with eight guides to prevent rocking or spillage.

Overall length of machine is 8' 6" and it is 2' 4" wide.



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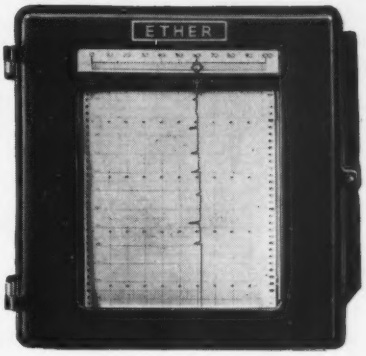

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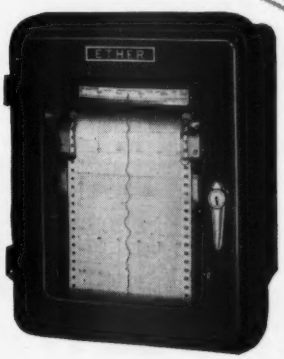

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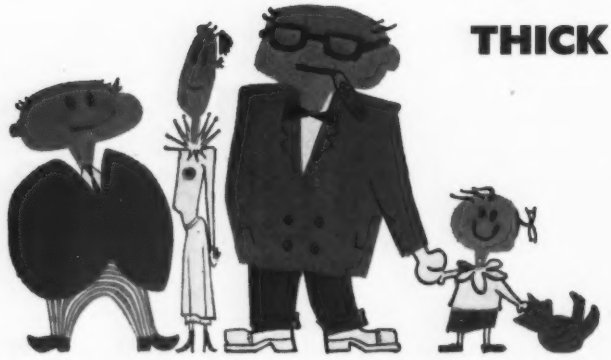

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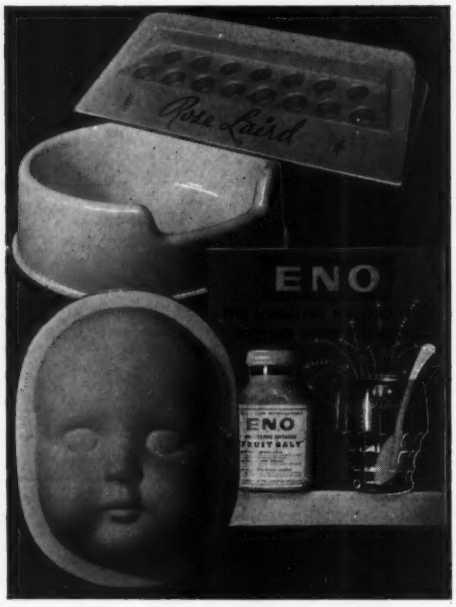

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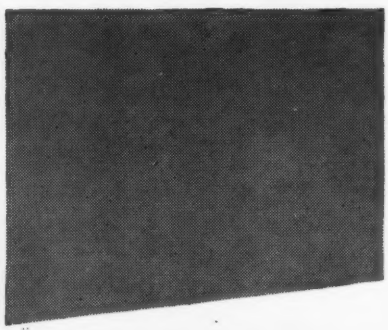

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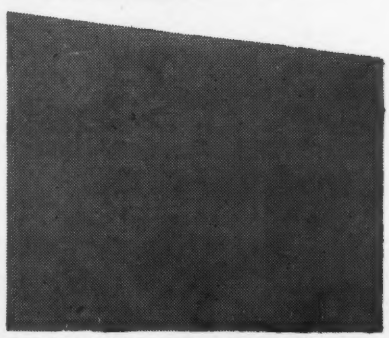

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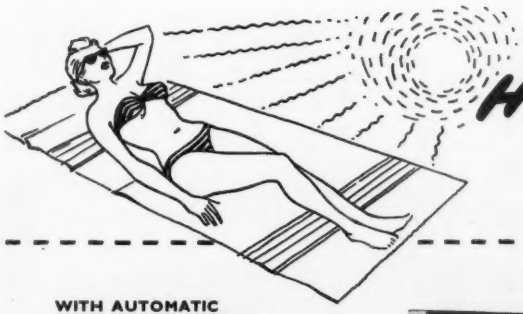

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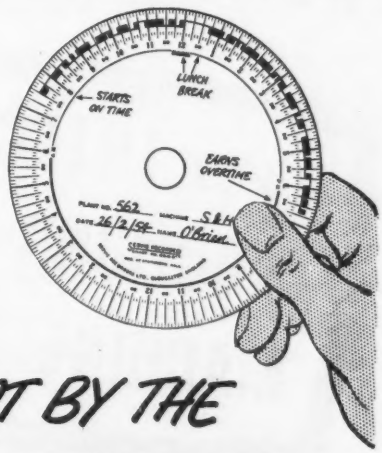

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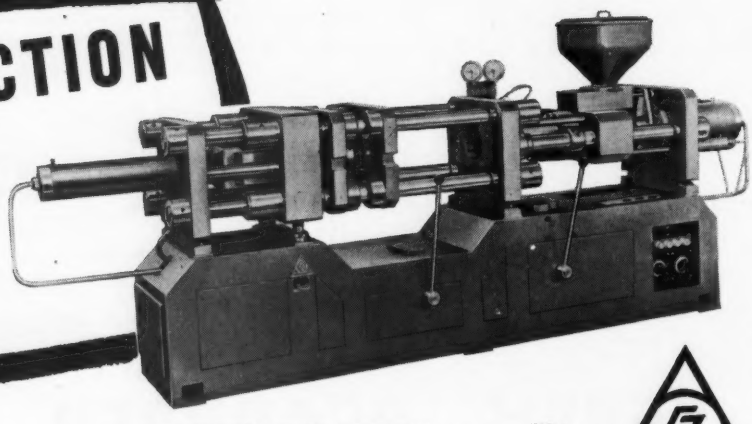

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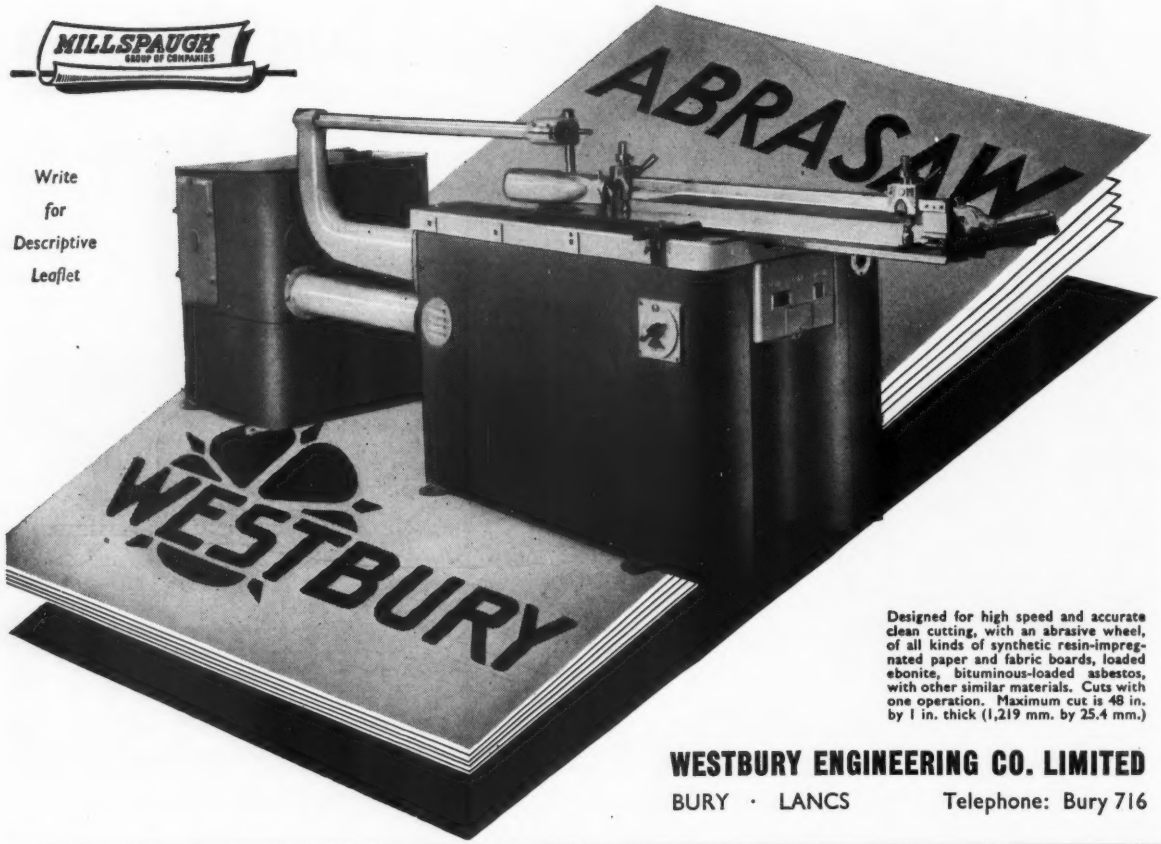

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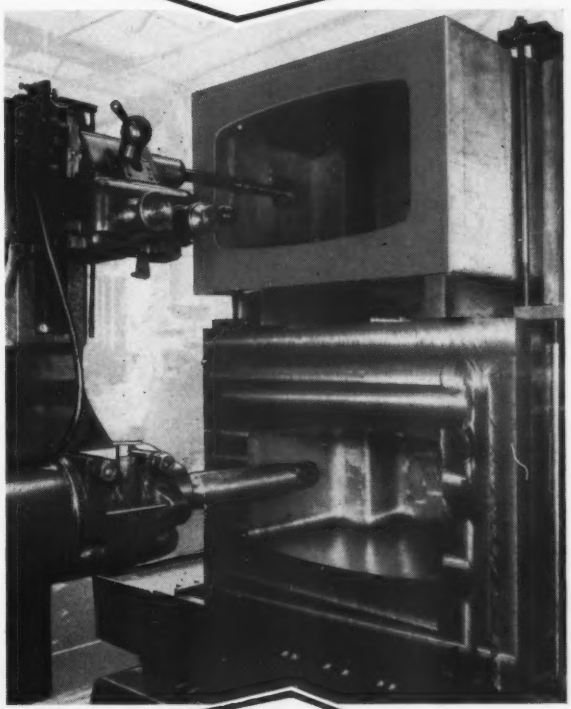

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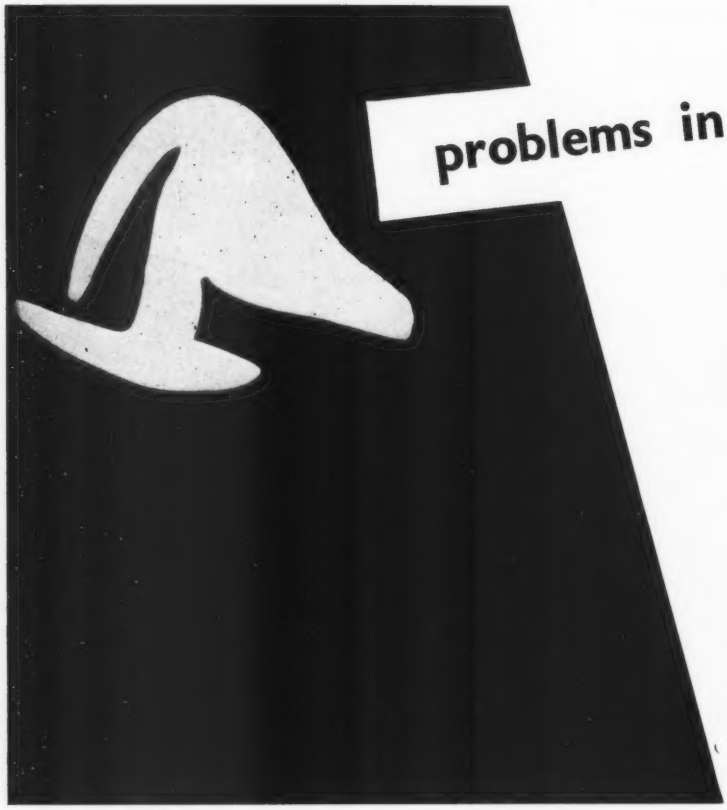

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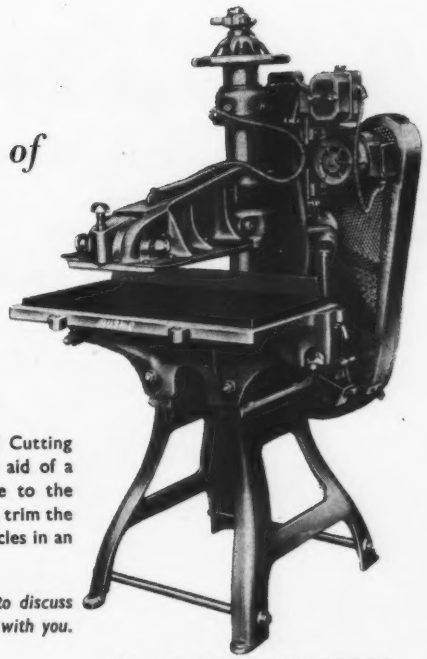

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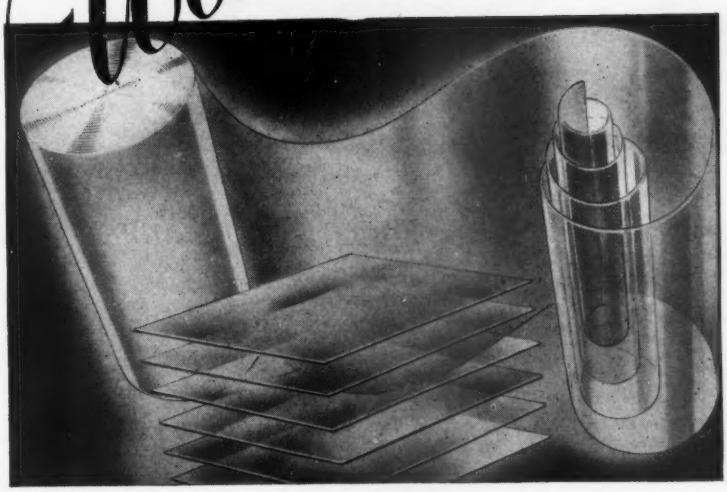

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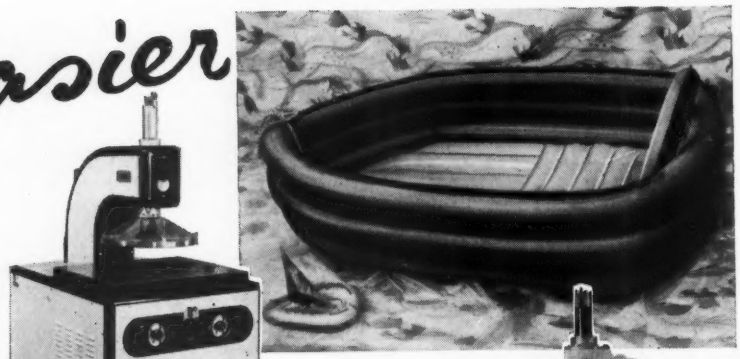

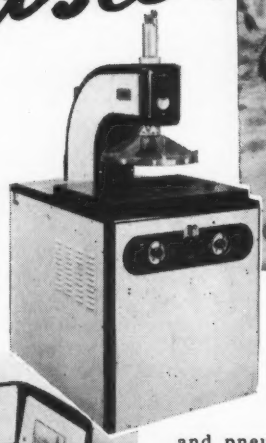

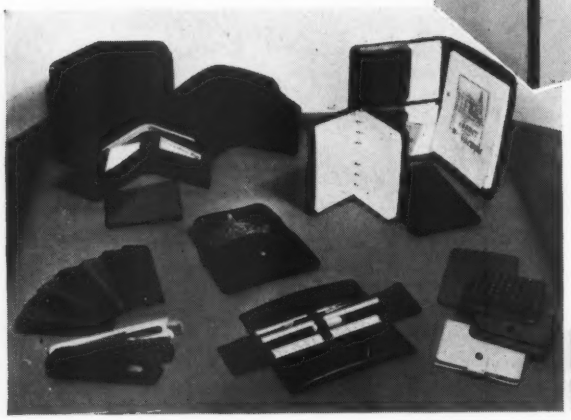

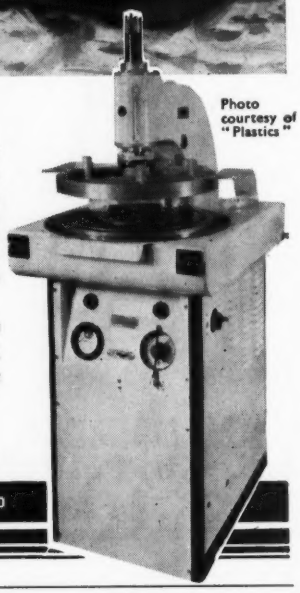

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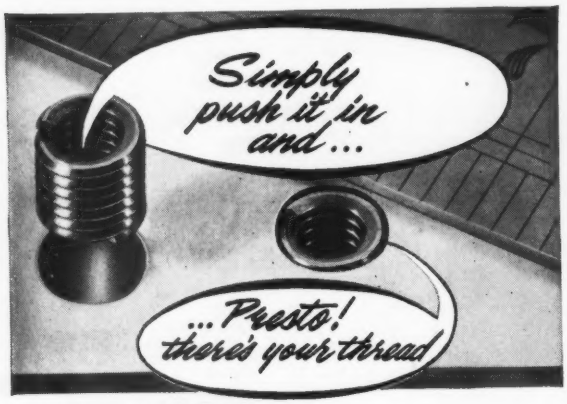

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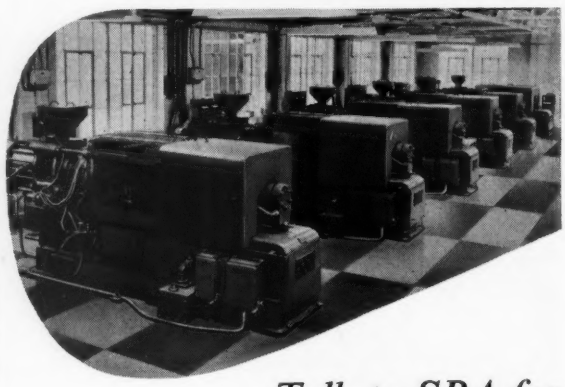

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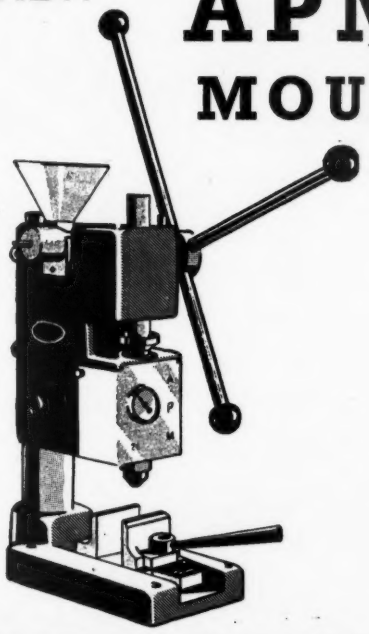

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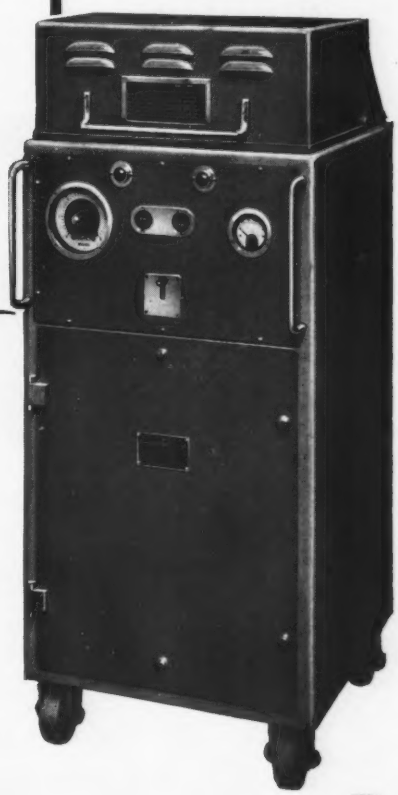

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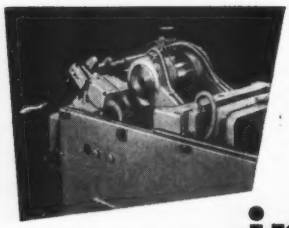

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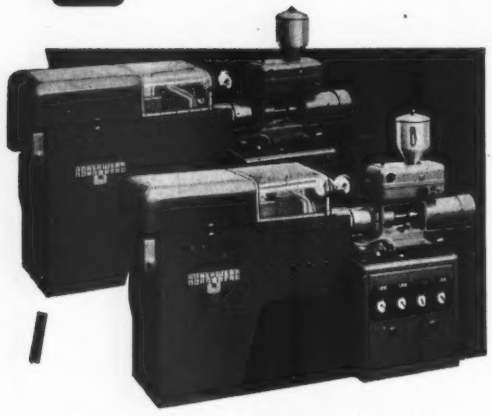

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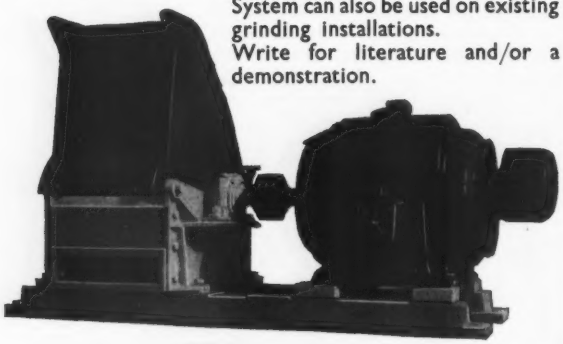

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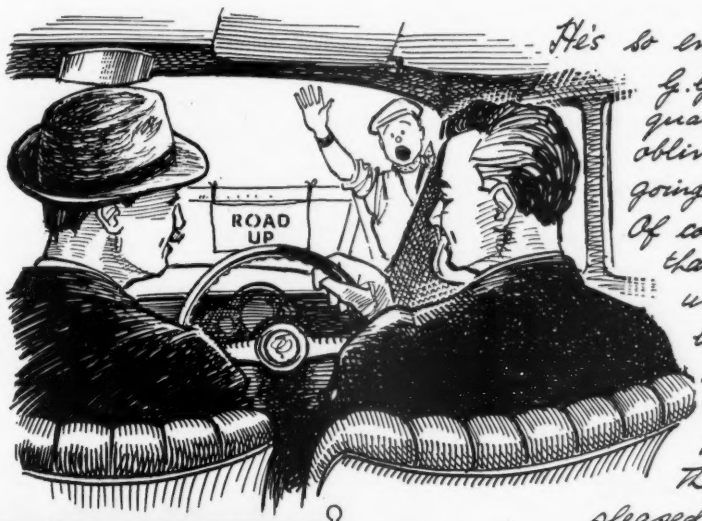

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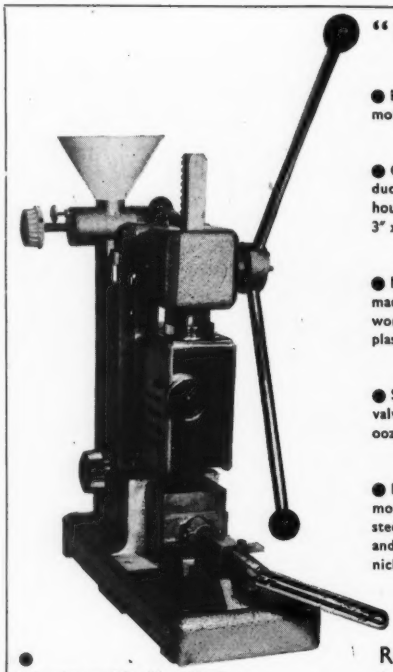

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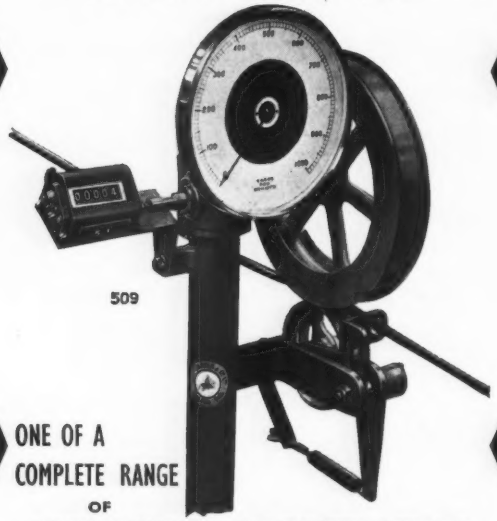

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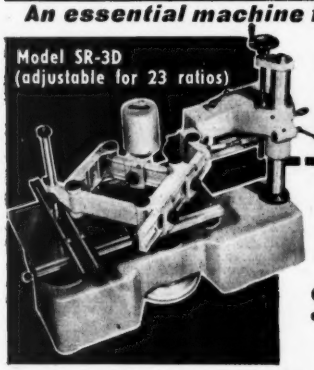

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400-ton UPSTROKE PRESS by Greenwood & Batley, Ram 16 in. dia. × 28 in. stroke. WP. 2 tons sq. in. Four columns 5 in. dia., distance between 22 in. × 17½ in. With nine steam-heated platens 36 in. × 17 in. giving eight daylights 2¾ in.

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80-ton DOWNSTROKE PRESS by Finney. Ram 10½ in. × 18 in. stroke. Four Columns 3 in. dia., distance between 21 in. × 10 in. WP. 1 ton sq. in. Fixed and fully guided moving tables, working area 18 in. sq.

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AND
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SITUATIONS VACANT

PLASTICS TECHNOLOGIST, or trainee, for work on problems in thermo-setting and thermo-plastic moulding for The Witton Moulded Insulation Works of the G.E.C. Age 22 to 25 years or younger if National Service completed or exempt. Qualifications: G.C.E., preferably at advanced level, in chemistry, physics and mathematics, or Diploma of Plastics Institute. Progressive staff position. Starting salary £550 to £650 per annum, according to age and experience.

Apply with full particulars to the Staff Manager, The General Electric Co., Ltd.. Witton, Birmingham. 229-16

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Experience in commercial body building, an ability to produce drawings, and experience of the application of reinforced plastics to either commercial vehicles or private cars is essential.

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Salary will be dependent on age and experience.

Applications giving full details to Box P298, care of " Plastics." 229-5

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MECHANICAL DEVELOPMENT ENGINEER with experience of plastic mould design and moulding operations required. London area. Write Box P295, care of " Plastics." 229-7

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229-15

MECHANICAL DEVELOPMENT ENGINEER required by electrical manufacturers for design and experimental work on special equipment for mass production projects. Some experience of plastic compression moulding essential. London area. Box P296, care of " Plastics." 229-8

TECHNICAL REPRESENTATIVE required for well-known injection moulding firm in North London specializing in trade moulding, to cover whole of Country except Home Counties and London. Trade connections an advantage but not essential. State age, experience and salary required, to Box P293, care of " Plastics." 229-10

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Situations Vacant (contd.)

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These are senior posts carrying substantial salaries. Please write stating age, qualifications and experience in confidence to Box P294, care of " Plastics." 229-9

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(*c*) Staff Mechanic who should have served an Apprenticeship to take charge of the model shop.

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ADHESIVE Tape Chemist.
Research laboratory in Scandinavia is looking for a well experienced pressure sensitive self-adhesive tape chemist or engineer for a permanent or periodical job. Must have a thorough practical as well as theoretical background. Good working conditions with all facilities as well as good salary. Please send detailed application (treated confidentially) with your education, previous experience and photograph to Box P2617, care of " Plastics." 229-35

Situations Vacant (contd.)

GENERAL MANAGER required P.V.C. and Polythene factory London area, capable taking complete charge. Good salary, excellent prospects. Assistance in house purchase if necessary. Apply full details Box P2729, care of " Plastics." 229-05133

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Please write for Application Form, quoting reference " P.6." to:—

Personnel Manager,
Metropolitan-Vickers Electrical Co., Ltd.,
Trafford Park, Manchester, 17. 229-44

Situations Vacant (contd.)

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BOOKS AND PUBLICATIONS

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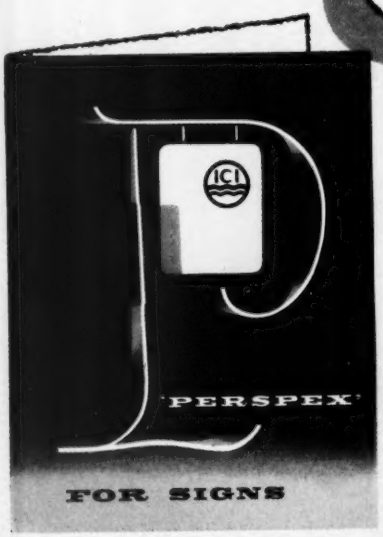

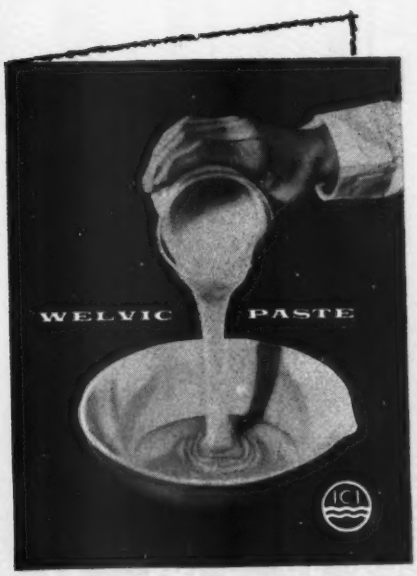

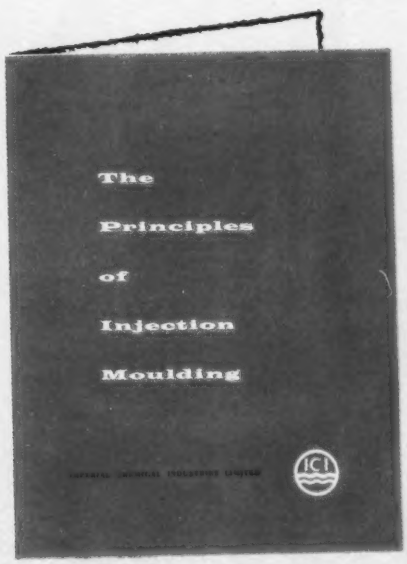

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